PROJECT MANUAL
FOR CONSTRUCTION OF

MiraCosta Community College
Community Learning Center
Student Services Building

1831 Mission Avenue
Oceanside, CA  92058

PREPARED FOR:
MiraCosta Community College District
1 Barnard Drive
Oceanside, CA  92056

ARCHITECT:
Lord Architecture, Inc.
11650 Iberia Place, Suite 210
San Diego, CA  92128

MCCCD Project No. 04001
LAi Project No. 1707-100
DSA Application No. 04-118054

JULY 10, 2019
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PROJECT

CLC Student Services Building
1831 Mission Avenue
Oceanside, CA 92058

OWNER

MiraCosta Community College District
1 Barnard Drive
Oceanside, CA 92056

ARCHITECT

Katherine I. Lord
ARCHITECT

Lord Architecture, Inc.
11650 Iberia Place, Suite 210
San Diego, CA 92128
Tel. (858) 485-6980

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Structural Safety

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SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Phased construction.
   4. Work by Owner.
   5. Work under separate contracts.
   6. Future work.
   7. Purchase contracts.
   8. Owner-furnished products.
   10. Access to site.
   11. Coordination with occupants.
   12. Work restrictions.

B. Related Requirements:
   1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: New Student Services Building
   1. Project Location: MiraCosta College – Community Learning Center
      1831 Mission Avenue, Oceanside, CA 92058

B. Owner: MiraCosta Community College District, 1 Barnard Drive, Oceanside, CA 92056
   1. Owner's Representative: Kitchell CEM.

C. Architect: Lord Architecture, Inc., 11650 Iberia Place, Suite 210, San Diego, CA 92128

D. Architect's Consultants: As indicated on Cover Sheet of Drawings.

E. Construction Manager: Kitchell CEM
   1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.

F. Web-Based Project Software: Project software administered by Construction Manager will be used for purposes of managing communication and documents during the construction stage.
   1. See Section 01 31 00 "Project Management and Coordination." for requirements for establishing and using web-based Project software.
1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
   1. Construction of a new Student Services Building and associated sitework, as indicated in the Contract Documents.

B. Type of Contract: Project will be constructed under a single prime contract.

1.5 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. No other construction project will be held concurrently. Owner will handle installation of IT switches, computers, printers, furniture, televisions, and certain audio-visual items.

1.6 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

B. Concurrent Work: Owner has awarded separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
   1. Monument Sign Project: To lowest qualified bidder. For removal of the Small Business Development Center Building, installation of a new Monument Sign, and other landscape and frontage improvements. The termination of this project site will share a site boundary with the Student Services Project. Plans are available upon request for coordination.
   2. Building at 1863 Mission (old Arby’s Restaurant) demolition: To lowest qualified bidder. For removal of the Arby’s Restaurant building. The area where the building currently sits will be graded and left vacant.

1.7 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

B. Owner-Furnished Products:
   2. Flat panel monitors as indicated in the drawings.

1.8 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
   1. Driveways, Walkways and Entrances: Keep driveways and loading areas, and entrances serving premises clear and available to Owner, Owner’s employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.9 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
   2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
   1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
   2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
   3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
   4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.10 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 4:00 p.m., Monday through Friday, unless otherwise indicated.
   1. Weekend Hours: Allowed if permission is granted by the District.
   2. Early Morning Hours: Allowed if permission is granted by the District.
   3. Hours for Utility Shutdowns: Allowed if permission is granted by the District. A minimum of 1-week notice is required.
   4. Hours for Core Drilling: Allowed if permission is granted by the District.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify Construction Manager not less than one week in advance of proposed utility interruptions.
   2. Obtain Construction Manager’s written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
   1. Notify Construction Manager not less than 72 hours in advance of proposed disruptive operations.
2. Obtain Construction Manager's written permission before proceeding with disruptive operations.

E. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.12 DIVISION OF STATE ARCHITECT (DSA) REQUIREMENTS

A. Comply with California Building Standards Code, Title 24, California Code of Regulations, Parts 1 through 6 and 9.

B. Title 24, Parts 1 through 5 must be kept on the site during construction.

C. All Addenda must be signed by the Architect and approved by DSA, per CAC, Section 4-338(b).

D. All substitutions affecting DSA-regulated items (e.g. material, system or product, etc.) shall be considered as a Construction Change Document or Addenda and shall be submitted and approved by DSA prior to fabrication and installation. (CAC, Section 4-338(c), IRA-6).

E. Construction Change Documents (CAC, Section 4-338(c)) must be signed by all the following:

1. Architect/Engineer of Record

2. Structural Engineer (when applicable)

3. Delegated professional engineer (when applicable)

4. DSA

F. Project Inspector and Testing Lab must be employed by the Owner (District) and be approved by all of the following:

1. Architect/Engineer of Record

2. Structural Engineer (when applicable)

3. DSA

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS
   A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
      1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
      2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES
   A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
      1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
   B. Execute accepted alternates under the same conditions as other work of the Contract.
   C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Vertical Folding Operable Partition in Conference Rooms.
   1. Base Bid: One open room consisting of rooms: Medium Conference 306 and Small Conference 307. Room has continuous acoustical grid ceiling as indicated in the Drawings.
   2. Alternate: Include the vertical folding operable partition, ceiling pocket, structural support, adjacent partition walls, power connection(s), and modified casework; as indicated on the drawings as “Alternate 1”; and as specified in Section 10 22 39 “Vertically-Folding Panel Partitions”.

B. Alternate No. 2: Patio and Seat-Wall in Quad.
   1. Base Bid: Concrete walkway through turfgrass area on south side of Quad; as indicated on the Drawings.
   2. Alternate: Includes concrete patio (in-lieu-of the concrete walkway), cast-in-place concrete seat-wall, and modified landscape planting and irrigation; as indicated on the Drawings as “Alternate 2”.

C. Alternate No. 3: Welcome Image on Curving Walls.
   1. Base Bid: Concrete stem walls along gridlines C1 and C3 with exterior finish and reveals/control joints as indicated on the Drawings.
   2. Alternate: For the exterior application on these concrete stem walls, install only reveals/control joints as indicated on the Drawings. Provide sand/media blast lettering on the exterior surface of the walls as indicated on the Drawings.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

A. Instructions to Bidders;

B. General Conditions, including, without limitation, Substitutions For Specified Items; and

C. Special Conditions.

1.2 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT

A. On October 18, 2018, April 18, 2019 and May 16, 2019, the Board of Trustees made certain findings and approved 36 specific materials, products, systems, services, and/or things pursuant to the exception found in Public Contract Code section 3400 (c) (2). The Board of Trustees’ findings and conclusions, as well as a list of those 36 specific materials, products, systems, services, and/or things are all set forth in the Resolutions passed by the Board of Trustees of the same dates which is set forth in this Request for Proposals document.

B. When not identified as a “sole-source” item, catalog numbers and specific brands or trade names followed by the designation "or equal" are used in conjunction with material and equipment required by the Specifications to establish the standards of quality, utility, and appearance required. Substitutions which are equal in quality, utility, and appearance to those specified may be reviewed subject to the provisions of the General Conditions.

C. Wherever more than one manufacturer's product is specified, the first-named product is the basis for the design used in the work and the use of alternative-named manufacturers' products or substitutes may require modifications in that design. If such alternatives are proposed by Contractor and are approved by the District and/or the Architect, Contractor shall assume all costs required to make necessary revisions and modifications of the design resulting from the substitutions requested by the Contractor.

D. When materials and equipment are specified by first manufacturer's name and product number, second manufacturer's name and "or approved equal," supporting data for the second product, if proposed by Contractor, shall be submitted in accordance with the requirements for substitutions.

E. The Contractor will not be allowed to substitute specified items unless the request for substitution is submitted as follows:

   1. District must receive any notice of request for substitution of a specified item a minimum of ten (10) calendar days prior to bid opening.
2. Within 35 days after the date of the Notice of Award, the Contractor shall submit data substantiating the request(s) for all substitution(s) containing sufficient information to assess acceptability of product or system and impact on Project, including, without limitation, the requirements specified in the Special Conditions and the technical Specifications. Insufficient information shall be grounds for rejection of substitution.

F. If the District and/or Architect, in reviewing proposed substitute materials and equipment, require revisions or corrections to be made to previously accepted Shop Drawings and supplemental supporting data to be resubmitted, Contractor shall promptly do so. If any proposed substitution is judged by the District and/or Architect to be unacceptable, the specified material or equipment shall be provided.

G. Samples may be required. Tests required by the District and/or Architect for the determination of quality and utility shall be made at the expense of Contractor, with acceptance of the test procedure first given by the District.

H. In reviewing the supporting data submitted for substitutions, the District and/or Architect will use for purposes of comparison all the characteristics of the specified material or equipment as they appear in the manufacturer's published data even though all the characteristics may not have been particularly mentioned in the Contract Documents. If more than two (2) submissions of supporting data are required, the cost of reviewing the additional supporting data shall be borne by Contractor, and the District will deduct the costs from the Contract Price. The Contractor shall be responsible for any re-design costs occasioned by District's acceptance and/or approval of any substitute.

I. The Contractor shall, in the event that a substitute is less costly than that specified, credit the District with one hundred percent (100%) of the net difference between the substitute and the originally specified material. In this event, the Contractor agrees to execute a deductive Change Order to reflect that credit. In the event Contractor furnishes a material, process, or article more expensive than that specified, the difference in the cost of that material, process, or article so furnished shall be borne by Contractor.

J. In no event shall the District be liable for any increase in Contract Price or Contract Time due to any claimed delay in the evaluation of any proposed substitute or in the acceptance or rejection of any proposed substitute.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF SECTION
SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications and acceptance of bid alternates.

1. Contractor shall comply with all applicable provisions in the Agreement, General Conditions, and Supplemental Conditions, if used, related to changes and/or requests for changes. See attached form for Change Order Requests (CORs)."

B. Related Requirements:

1. Section 01 25 13 "Product Options and Substitutions" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions" or equivalent form.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

   c. Include costs of labor and supervision directly attributable to the change.

   d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

   e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail," or other forms acceptable to Architect and Owner.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include costs of labor and supervision directly attributable to the change.

5. Include an updated Contractor’s construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 01 25 13 "Product Options and Substitutions" if the proposed change requires substitution of one product or system for product or system specified.


1.5 CHANGE ORDER PROCEDURES

A. On Owner’s approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or similar approved form.

1.6 CONSTRUCTION CHANGE DIRECTIVE


1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 ALTERNATES

A. Definition of Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

B. Procedures:

1. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

2. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

C. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
D. Execute accepted alternates under the same conditions as other work of the Contract.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION
SECTION 01 29 00
APPLICATION FOR PAYMENT AND
CONDITIONAL AND UNCONDITIONAL WAIVER AND RELEASE FORMS

CONTRACTOR SHALL COMPLY WITH ALL PROVISIONS IN THE GENERAL CONDITIONS
RELATED TO APPLICATIONS FOR PAYMENT AND/OR PAYMENTS.
CONDITIONAL WAIVER AND RELEASE
ON PROGRESS PAYMENT
(CIVIL CODE SECTION 8132)

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE,
AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON
SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS
RECEIVED PAYMENT.

Name of Claimant: _____________________________________________________________

Name of Customer: _____________________________________________________________

Job Location: _________________________________________________________________

Owner: _______________________________________________________________________

Through Date: __________________________________________________________________

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the
claimant has for labor and service provided, and equipment and material delivered, to the
customer on this job through the Through Date of this document. Rights based upon labor or
service provided, or equipment or material delivered, pursuant to a written change order that
has been fully executed by the parties prior to the date that this document is signed by the
claimant, are waived and released by this document, unless listed as an Exception below. This
document is effective only on the claimant's receipt of payment from the financial institution on
which the following check is drawn:

Maker of Check: __________________________________________________________________

Amount of Check: $______________________________

Check Payable to: ______________________________________________________________

Exceptions

This document does not affect any of the following:

(1) Retentions.

(2) Extras for which the claimant has not received payment.

(3) The following progress payments for which the claimant has previously given a
conditional waiver and release but has not received payment:

Date(s) of waiver and release: ___________________________________________________

Amount(s) of unpaid progress payment(s): $______________________________
(4) Contract rights, including (A) a right based on rescission, abandonment, or breach of contract, and (B) the right to recover compensation for work not compensated by the payment.

Claimant's Signature: ________________________________

Claimant's Title: ________________________________

Date of Signature: ________________________________
UNCONDITIONAL WAIVER AND RELEASE
ON PROGRESS PAYMENT
(CIVIL CODE SECTION 8134)

NOTICE TO CLAIMANT: THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP
PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES
THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS
ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF
YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Name of Claimant: ____________________________

Name of Customer: ____________________________

Job Location: ____________________________

Owner: ____________________________

Through Date: ____________________________

Unconditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the
claimant has for labor and service provided, and equipment and material delivered, to the
customer on this job through the Through Date of this document. Rights based upon labor or
service provided, or equipment or material delivered, pursuant to a written change order that
has been fully executed by the parties prior to the date that this document is signed by the
claimant, are waived and released by this document, unless listed as an Exception below. The
claimant has received the following progress payment: $__________________________

Exceptions

This document does not affect any of the following:

(1) Retentions.

(2) Extras for which the claimant has not received payment.

(3) Contract rights, including (A) a right based on rescission, abandonment, or
breach of contract, and (B) the right to recover compensation for work not
compensated by the payment.

Claimant's Signature: ____________________________

Claimant's Title: ____________________________

Date of Signature: ____________________________
CONDITIONAL WAIVER AND RELEASE
ON FINAL PAYMENT
(CIVIL CODE SECTION 8136)

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Name of Claimant: _______________________________________________________

Name of Customer: _______________________________________________________

Job Location: ___________________________________________________________

Owner: __________________________________________________________________

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check: __________________________________________________________________

Amount of Check: $___________________________________________________________

Check Payable to: __________________________________________________________

Exceptions

This document does not affect any of the following: _____________________________

Disputed claims for extras in the amount of: $____________________________________

Claimant's Signature: _______________________________________________________

Claimant's Title: ___________________________________________________________

Date of Signature: _________________________________________________________
UNCONDITIONAL WAIVER AND RELEASE
ON FINAL PAYMENT
(CIVIL CODE SECTION 8138)

NOTICE TO CLAIMANT: THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Name of Claimant: 
Name of Customer: 
Job Location: 
Owner: 

Unconditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for all labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. The claimant has been paid in full.

Exceptions

This document does not affect any of the following: 
Disputed claims for extras in the amount of: $
Claimant's Signature: 
Claimant's Title: 
Date of Signature: 
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. Requests for Information (RFIs).
   4. Project meetings.

B. Related Requirements:
   1. Section 01 32 13 "Scheduling of Work" for preparing and submitting Contractor's construction schedule.
   2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

B. BIM: Building Information Modeling.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
      b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
      c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.

4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.

2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
   a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
   b. Digital Data Software Program: Drawings are available in AutoCAD 2013.
   c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.7 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
   1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
   2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor and Construction Manager.
   5. Name of Architect.
   6. RFI number, numbered sequentially.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
       a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.
   1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Architect's and Construction Manager's Actions: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
       a. Requests for approval of submittals.
       b. Requests for approval of substitutions.
       c. Requests for approval of Contractor's means and methods.
       d. Requests for coordination information already indicated in the Contract Documents.
       e. Requests for adjustments in the Contract Time or the Contract Sum.
       f. Requests for interpretation of Architect's actions on submittals.
       g. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log with not less than the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect and Construction Manager.
   4. RFI number including RFIs that were returned without action or withdrawn.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's and Construction Manager's response was received.

F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.
   1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
   1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
   2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
   4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement.
      a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106- Digital Data Licensing Agreement.

B. Web-Based Project Management Software Package: Use Construction Manager's web-based Project management software package (Prolog) for purposes of hosting and managing Project communication and documentation until Final Completion.
   1. Web-based Project management software includes, at a minimum, the following features:
      a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
      b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
      c. Document workflow planning, allowing customization of workflow between project entities.
      d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
      e. Track status of each Project communication in real time, and log time and date when responses are provided.
      f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
      g. Processing and tracking of payment applications.
      h. Processing and tracking of contract modifications.
1. Creating and distributing meeting minutes.
2. Document management for Drawings, Specifications, and coordination drawings, including revision control.
4. Mobile device compatibility, including smartphones and tablets.
5. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
6. Web-based Project software package is: Trimble; Prolog Converge.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Construction Manager and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager and Architect, within three days of the meeting.

B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 20 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Project Inspector, Construction Manager, Architect and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule.
   b. Responsibilities and personnel assignments.
   c. Phasing.
   d. Critical work sequencing and long-lead items.
   e. Designation of key personnel and their duties.
   f. Lines of communications.
   g. Procedures for processing field decisions and Change Orders.
   h. Procedures for RFIs.
   i. Procedures for testing and inspecting.
   j. Procedures for processing Applications for Payment.
   k. Distribution of the Contract Documents.
   l. Submittal procedures.
   m. Sustainable design requirements.
   n. Preparation of record documents.
   o. Use of the premises.
   p. Work restrictions.
   q. Working hours.
   r. Owner's occupancy requirements.
   s. Responsibility for temporary facilities and controls.
t. Procedures for moisture and mold control.
u. Procedures for disruptions and shutdowns.
v. Construction waste management and recycling.
w. Parking availability.
x. Office, work, and storage areas.
y. Equipment deliveries and priorities.
z. First aid.
bb. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each major construction activity that requires coordination with other construction. These conferences are generally stated in Part 1 of each Specification Section.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Owner's Commissioning Authority, Project Inspector, and Construction Manager of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Sustainable design requirements.
   i. Review of mockups.
   j. Possible conflicts.
   k. Compatibility requirements.
   l. Time schedules.
   m. Weather limitations.
   n. Manufacturer's written instructions.
   o. Warranty requirements.
   q. Acceptability of substrates.
   r. Temporary facilities and controls.
   s. Space and access limitations.
   t. Regulations of authorities having jurisdiction.
   u. Testing and inspecting requirements.
   v. Installation procedures.
   w. Coordination with other work.
   x. Required performance results.
   y. Protection of adjacent work.
   z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 60 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.

2. Attendees: Authorized representatives of Owner, Architect and their consultants, Owner's Commissioning Authority, Project Inspector, Construction Manager and Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
   a. Preparation of record documents.
   b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
   c. Requirements and procedures for obtaining DSA certification.
   d. Submittal of written warranties.
   e. Requirements for completing sustainable design documentation.
   f. Requirements for preparing operations and maintenance data.
   g. Requirements for delivery of material samples, attic stock, and spare parts.
   h. Requirements for demonstration and training.
   i. Preparation of Contractor's punch list.
   j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
   k. Submittal procedures.
   l. Coordination of separate contracts.
   m. Owner's partial occupancy requirements.
   n. Installation of Owner's furniture, fixtures, and equipment.
   o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of Owner, Architect, Construction Manager, Contractor, pertinent subcontractors, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      1) Review schedule for next period.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Status of sustainable design documentation.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site utilization.
      9) Temporary facilities and controls.
      10) Progress cleaning.
      11) Quality and work standards.
      12) Status of correction of deficient items.
      13) Field observations.
14) Status of RFIs.
15) Status of proposal requests.
16) Pending changes.
17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
   a. Schedule Updating: Revise Contractor’s construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
SECTION 01 32 13
SCHEDULING OF WORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:
1. General Conditions;
2. Special Conditions;
3. Summary of Work; and

1.2 SECTION INCLUDES

A. Scheduling of Work under this Contract shall be performed by Contractor in accordance with requirements of this Section.
1. Development of schedule, cost and resource loading of the schedule, monthly payment requests, and project status reporting requirements of the Contract shall employ computerized Critical Path Method (“CPM”) scheduling (“CPM Schedule”).
2. CPM Schedule shall be cost loaded based on Schedule of Values as approved by District.
3. Submit schedules and reports as specified in the General Conditions.

Upon Award of Contract, Contractor shall immediately commence development of Initial and Original CPM Schedules to ensure compliance with CPM Schedule submittal requirements.

1.3 CONSTRUCTION SCHEDULE

A. Within fourteen (14) calendar days after the date of Award of the Contract, and before request for first progress payment, the Contractor shall prepare and submit to the PMO a construction progress schedule conforming to the Milestone Schedule below. The Construction Schedule shall be continuously updated, and an updated schedule shall be submitted with each application for progress payment. Each revised schedule shall indicate the work actually accomplished during the previous period and the schedule for completion of the remaining work.

1.4 QUALIFICATIONS

A. Contractor shall employ experienced scheduling personnel qualified to use the latest version of [i.e., Primavera Project Planner]. Experience level required is set forth below. Contractor may employ such personnel directly or may employ a consultant for this purpose.
1. The written statement shall identify the individual who will perform CPM scheduling.
2. Capability and experience shall be verified by description of construction projects on which individual has successfully applied computerized CPM.
3. Required level of experience shall include at least two (2) projects of similar nature and scope with value not less than three fourths (¾) of the Total Bid Price of this Project. The written statement shall provide contact persons for referenced projects with current telephone and address information.

District reserves the right to approve or reject Contractor’s scheduler or consultant at any time. District reserves the right to refuse replacing of Contractor’s scheduler or consultant, if District believes replacement will negatively affect the scheduling of Work under this Contract.

1.5 GENERAL

A. Progress Schedule shall be based on and incorporate milestone and completion dates specified in Contract Documents.

Overall time of completion and time of completion for each milestone shown on Progress Schedule shall adhere to times in the Contract, unless an earlier (advanced) time of completion is requested by Contractor and agreed to by District. Any such agreement shall be formalized by a Change Order.

1. District is not required to accept an early completion schedule, i.e., one that shows an earlier completion date than the Contract Time.

2. Contractor shall not be entitled to extra compensation in event agreement is reached on an earlier completion schedule and Contractor completes its Work, for whatever reason, beyond completion date shown in its early completion schedule but within the Contract Time.

3. A schedule showing the work completed in less than the Contract Time, and that has been accepted by District, shall be considered to have Project Float. The Project Float is the time between the scheduled completion of the work and the Completion Date. Project Float is a resource available to both District and the Contractor.

Ownership Project Float: Neither the District nor Contractor owns Project Float. The Project owns the Project Float. As such, liability for delay of the Completion Date rests with the party whose actions, last in time, actually cause delay to the Completion Date.

1. For example, if Party A uses some, but not all of the Project Float and Party B later uses remainder of the Project Float as well as additional time beyond the Project Float, Party B shall be liable for the time that represents a delay to the Completion Date.

2. Party A would not be responsible for the time since it did not consume the entire Project Float and additional Project Float remained; therefore, the Completion Date was unaffected by Party A.

Progress Schedule shall be the basis for evaluating job progress, payment requests, and time extension requests. Responsibility for developing Contract CPM Schedule and monitoring actual progress as compared to Progress Schedule rests with Contractor.

Failure of Progress Schedule to include any element of the Work, or any inaccuracy in Progress Schedule, will not relieve Contractor from responsibility for accomplishing the Work in accordance with the Contract. District’s acceptance of schedule shall be for its use in monitoring and evaluating job progress, payment requests, and time extension requests and shall not, in any manner, impose a duty of care upon District, or act to relieve Contractor of its responsibility for means and methods of construction.
Software: Use **P6 (Primavera) or District-approved equal.** Such software shall be compatible with Windows operating system. Contractor shall transmit contract file to District on compact disk at times requested by District.

Transmit each item under the form approved by District.
1. Identify Project with District Contract number and name of Contractor.
2. Provide space for Contractor’s approval stamp and District’s review stamps.
3. Submittals received from sources other than Contractor will be returned to the Contractor without District’s review.

1.6 INITIAL CPM SCHEDULE

A. Initial CPM Schedule submitted for review at the pre-construction conference shall serve as Contractor’s schedule for up to ninety (90) calendar days after the Notice to Proceed.

Indicate detailed plan for the Work to be completed in first ninety (90) days of the Contract; details of planned mobilization of plant and equipment; sequence of early operations; procurement of materials and equipment. Show Work beyond ninety (90) calendar days in summary form.

Initial CPM Schedule shall be time scaled.

Initial CPM Schedule shall be cost and resource loaded. Accepted cost and resource loaded schedule will be used as basis for monthly progress payments until acceptance of the Original CPM Schedule. Use of Initial CPM Schedule for progress payments shall not exceed ninety (90) calendar days.

District and Contractor shall meet to review and discuss the Initial CPM Schedule within seven (7) calendar days after it has been submitted to District.
1. District’s review and comment on the schedule shall be limited to Contract conformance (with sequencing, coordination, and milestone requirements).
2. Contractor shall make corrections to schedule necessary to comply with Contract requirements and shall adjust schedule to incorporate any missing information requested by District. Contractor shall resubmit Initial CPM Schedule if requested by District.

If, during the first ninety (90) days after Notice to Proceed, the Contractor believes any of the Work included on its Initial CPM Schedule has been impacted, the Contractor shall submit to District a written Time Impact Evaluation ("TIE") in accordance with Article 1.12 of this Section. The TIE shall be based on the most current update of the Initial CPM Schedule.

1.7 ORIGINAL CPM SCHEDULE

A. Submit a detailed proposed Original CPM Schedule presenting an orderly and realistic plan for completion of the Work in conformance with requirements as specified herein.

Progress Schedule shall include or comply with following requirements:
1. Time scaled, cost and resource (labor and major equipment) loaded CPM schedule.
2. No activity on schedule shall have duration longer than fifteen (15) work days, with exception of submittal, approval, fabrication and procurement activities, unless otherwise approved by District.
   a. Activity durations shall be total number of actual work days required to perform that activity.
3. The start and completion dates of all items of Work, their major components, and milestone completion dates, if any.
4. District furnished materials and equipment, if any, identified as separate activities.
5. Activities for maintaining Project Record Documents.
6. Dependencies (or relationships) between activities.
7. Processing/approval of submittals and shop drawings for all material and equipment required per the Contract. Activities that are dependent on submittal acceptance or material delivery shall not be scheduled to start earlier than expected acceptance or delivery dates.
   a. Include time for submittals, re-submittals and reviews by District.
   b. Contractor shall be responsible for all impacts resulting from re-submittal of Shop Drawings and submittals.
8. Procurement of major equipment, through receipt and inspection at jobsite, identified as separate activity.
   a. Include time for fabrication and delivery of manufactured products for the Work.
   b. Show dependencies between procurement and construction.
9. Activity description; what Work is to be accomplished and where.
10. The total cost of performing each activity shall be total of labor, material, and equipment, excluding overhead and profit of Contractor. Overhead and profit of the General Contractor shall be shown as a separate activity in the schedule. Sum of cost for all activities shall equal total Contract value.
11. Resources required (labor and major equipment) to perform each activity.
12. Responsibility code for each activity corresponding to Contractor or Subcontractor responsible for performing the Work.
13. Identify the activities which constitute the controlling operations or critical path. No more than twenty-five (25%) of the activities shall be critical or near critical. Near critical is defined as float in the range of one (1) to (10) days.
14. Thirty (30) calendar days for developing punch list(s), completion of punch-list items, and final clean up for the Work or any designated portion thereof. No other activities shall be scheduled during this period.
15. Interface with the work of other contractors, District, and agencies such as, but not limited to, utility companies.
16. Show detailed Subcontractor Work activities. In addition, furnish copies of Subcontractor schedules upon which CPM was built.
   a. Also furnish for each Subcontractor, as determined by District, submitted on Subcontractor letterhead, a statement certifying that Subcontractor concurs with Contractor’s Original CPM Schedule and that Subcontractor’s related schedules have been incorporated, including activity duration, cost and resource loading.
   b. Subcontractor schedules shall be independently derived and not a copy of Contractor’s schedule.
   c. In addition to Contractor’s schedule and resource loading, obtain from electrical, mechanical, and plumbing Subcontractors, and other Subcontractors as required by District, productivity calculations common to...
their trades, such as units per person day, feet of pipe per day per person, feet of wiring per day per person, and similar information.

d. Furnish schedule for Contractor/Subcontractor CPM schedule meetings which shall be held prior to submission of Original CPM schedule to District. District shall be permitted to attend scheduled meetings as an observer.

17. Activity durations shall be in Work days.

18. Submit with the schedule a list of anticipated non-Work days, such as weekends and holidays. The Progress Schedule shall exclude in its Work day calendar all non-Work days on which Contractor anticipates critical Work will not be performed.

Original CPM Schedule Review Meeting: Contractor shall, within sixty (60) days from the Notice to Proceed date, meet with District to review the Original CPM Schedule submittal.

1. Contractor shall have its Project Manager, Project Superintendent, Project Scheduler, and key Subcontractor representatives, as required by District, in attendance. The meeting will take place over a continuous one (1) day period.

2. District’s review will be limited to submittal’s conformance to Contract requirements including, but not limited to, coordination requirements. However, review may also include:
   b. Directions to include activities and information missing from submittal.
   c. Requests to Contractor to clarify its schedule.

3. Within five (5) days of the Schedule Review Meeting, Contractor shall respond in writing to all questions and comments expressed by District at the Meeting.

1.8 ADJUSTMENTS TO CPM SCHEDULE

A. Adjustments to Original CPM Schedule: Contractor shall have adjusted the Original CPM Schedule submittal to address all review comments from original CPM Schedule review meeting and resubmit network diagrams and reports for District’s review.

1. District, within ten (10) days from date that Contractor submitted the revised schedule, will either:
   a. Accept schedule and cost and resource loaded activities as submitted, or
   b. Advise Contractor in writing to review any part or parts of schedule which either do not meet Contract requirements or are unsatisfactory for District to monitor Project’s progress, resources, and status or evaluate monthly payment request by Contractor.

2. District may accept schedule with conditions that the first monthly CPM Schedule update be revised to correct deficiencies identified.

3. When schedule is accepted, it shall be considered the “Original CPM Schedule” which will then be immediately updated to reflect the current status of the work.

4. District reserves right to require Contractor to adjust, add to, or clarify any portion of schedule which may later be discovered to be insufficient for monitoring of Work or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

Acceptance of Contractor’s schedule by District will be based solely upon schedule’s compliance with Contract requirements.

1. By way of Contractor assigning activity durations and proposing sequence of Work, Contractor agrees to utilize sufficient and necessary management and other resources to perform work in accordance with the schedule.
2. Upon submittal of schedule update, updated schedule shall be considered "current" CPM Schedule.

3. Submission of Contractor’s schedule to District shall not relieve Contractor of total responsibility for scheduling, sequencing, and pursuing Work to comply with requirements of Contract Documents, including adverse effects such as delays resulting from ill-timed Work.

Submittal of Original CPM Schedule, and subsequent schedule updates, shall be understood to be Contractor’s representation that the Schedule meets requirements of Contract Documents and that Work shall be executed in sequence indicated on the schedule.

Contractor shall distribute Original CPM Schedule to Subcontractors for review and written acceptance, which shall be noted on Subcontractors’ letterheads to Contractor and transmitted to District for the record.

1.9 MONTHLY CPM SCHEDULE UPDATE SUBMITTALS

A. Following acceptance of Contractor’s Original CPM Schedule, Contractor shall monitor progress of Work and adjust schedule each month to reflect actual progress and any anticipated changes to planned activities.

1. Each schedule update submitted shall be complete, including all information requested for the Original CPM Schedule submittal.

2. Each update shall continue to show all Work activities including those already completed. These completed activities shall accurately reflect “as built” information by indicating when activities were actually started and completed.

A meeting will be held on approximately the twenty-fifth (25th) of each month to review the schedule update submittal and progress payment application.

1. At this meeting, at a minimum, the following items will be reviewed: Percent (%) complete of each activity; Time Impact Evaluations for Change Orders and Time Extension Request; actual and anticipated activity sequence changes; actual and anticipated duration changes; and actual and anticipated Contractor delays.

2. These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, these meetings shall be attended by Contractor’s General Superintendent and Scheduler.

3. Contractor shall plan on the meeting taking no less than four (4) hours.

Within five (5) working days after monthly schedule update meeting, Contractor shall submit the updated CPM Schedule update.

Within five (5) work days of receipt of above noted revised submittals, District will either accept or reject monthly schedule update submittal.

1. If accepted, percent (%) complete shown in monthly update will be basis for Application for Payment by the Contractor. The schedule update shall be submitted as part of the Contractor’s Application for Payment.

2. If rejected, update shall be corrected and resubmitted by Contractor before the Application for Payment is submitted.

Neither updating, changing or revising of any report, curve, schedule, or narrative submitted to District by Contractor under this Contract, nor District’s review or acceptance of any such report, curve, schedule or narrative shall have the effect of
amending or modifying in any way the Completion Date or milestone dates or of modifying or limiting in any way Contractor's obligations under this Contract.

1.10 SCHEDULE REVISIONS

A. Updating the Schedule to reflect actual progress shall not be considered revisions to the Schedule. Since scheduling is a dynamic process, revisions to activity durations and sequences are expected on a monthly basis.

To reflect revisions to the Schedule, the Contractor shall provide District with a written narrative with a full description and reasons for each Work activity revised. For revisions affecting the sequence of work, the Contractor shall provide a schedule diagram which compares the original sequence to the revised sequence of work. The Contractor shall provide the written narrative and schedule diagram for revisions two (2) working days in advance of the monthly schedule update meeting.

Schedule revisions shall not be incorporated into any schedule update until the revisions have been reviewed by District. District may request further information and justification for schedule revisions and Contractor shall, within three (3) days, provide District with a complete written narrative response to District’s request.

If the Contractor’s revision is still not accepted by District, and the Contractor disagrees with District’s position, the Contractor has seven (7) calendar days from receipt of District’s letter rejecting the revision to provide a written narrative providing full justification and explanation for the revision. The Contractor’s failure to respond in writing within seven (7) calendar days of District’s written rejection of a schedule revision shall be contractually interpreted as acceptance of District’s position, and the Contractor waives its rights to subsequently dispute or file a claim regarding District’s position.

At District’s discretion, the Contractor can be required to provide Subcontractor certifications of performance regarding proposed schedule revisions affecting said Subcontractors.

1.11 RECOVERY SCHEDULE

A. If the Schedule Update shows a completion date twenty-one (21) calendar days beyond the Contract Completion Date, or individual milestone completion dates, the Contractor shall submit to District the proposed revisions to recover the lost time within seven (7) calendar days. As part of this submittal, the Contractor shall provide a written narrative for each revision made to recapture the lost time. If the revisions include sequence changes, the Contractor shall provide a schedule diagram comparing the original sequence to the revised sequence of work.

The revisions shall not be incorporated into any schedule update until the revisions have been reviewed by District.

If the Contractor’s revisions are not accepted by District, District and the Contractor shall follow the procedures in paragraph 1.09.C, 1.09.D and 1.09.E above.

At District’s discretion, the Contractor can be required to provide Subcontractor certifications for revisions affecting said Subcontractors.

1.12 TIME IMPACT EVALUATION (“TIE”) FOR CHANGE ORDERS, AND OTHER DELAYS
A. When Contractor is directed to proceed with changed Work, the Contractor shall prepare and submit within fourteen (14) calendar days from the Notice to Proceed a TIE which includes both a written narrative and a schedule diagram depicting how the changed Work affects other schedule activities. The schedule diagram shall show how the Contractor proposes to incorporate the changed Work in the schedule and how it impacts the current schedule-update critical path. The Contractor is also responsible for requesting time extensions based on the TIE’s impact on the critical path. The diagram must be tied to the main sequence of schedule activities to enable District to evaluate the impact of changed Work to the scheduled critical path.

Contractor shall be required to comply with the requirements of Paragraph 1.09.A for all types of delays such as, but not limited to, Contractor/Subcontractor delays, adverse weather delays, strikes, procurement delays, fabrication delays, etc.

Contractor shall be responsible for all costs associated with the preparation of TIEs, and the process of incorporating them into the current schedule update. The Contractor shall provide District with four (4) copies of each TIE.

Once agreement has been reached on a TIE, the Contract Time will be adjusted accordingly. If agreement is not reached on a TIE, the Contract Time may be extended in an amount District allows, and the Contractor may submit a claim for additional time claimed by contractor.

1.13 TIME EXTENSIONS

A. The Contractor is responsible for requesting time extensions for time impacts that, in the opinion of the Contractor, impact the critical path of the current schedule update. Notice of time impacts shall be given in accord with the General Conditions.

Where an event for which District is responsible impacts the projected Completion Date, the Contractor shall provide a written mitigation plan, including a schedule diagram, which explains how (e.g., increase crew size, overtime, etc.) the impact can be mitigated. The Contractor shall also include a detailed cost breakdown of the labor, equipment, and material the Contractor would expend to mitigate District-caused time impact. The Contractor shall submit its mitigation plan to District within fourteen (14) calendar days from the date of discovery of the impact. The Contractor is responsible for the cost to prepare the mitigation plan.

Failure to request time, provide TIE, or provide the required mitigation plan will result in Contractor waiving its right to a time extension and cost to mitigate the delay.

No time will be granted under this Contract for cumulative effect of changes.

District will not be obligated to consider any time extension request unless the Contractor complies with the requirements of Contract Documents.

Failure of the Contractor to perform in accordance with the current schedule update shall not be excused by submittal of time extension requests.

If the Contractor does not submit a TIE within the required fourteen (14) calendar days for any issue, it is mutually agreed that the Contractor does not require a time extension for said issue.

1.14 SCHEDULE REPORTS
A. Submit four (4) copies of the following reports with the Initial CPM Schedule, the Original CPM Schedule, and each monthly update.

Required Reports:
1. Two activity listing reports: one sorted by activity number and one by total Project Float. These reports shall also include each activity’s early/late and actual start and finish dates, original and remaining duration, Project Float, responsibility code, and the logic relationship of activities.
2. Cost report sorted by activity number including each activity’s associated cost, percentage of Work accomplished, earned value- to date, previous payments, and amount earned for current update period.
3. Schedule plots presenting time-scaled network diagram showing activities and their relationships with the controlling operations or critical path clearly highlighted.
4. Cash flow report calculated by early start, late start, and indicating actual progress. Provide an exhibit depicting this information in graphic form.
5. Planned versus actual resource (i.e., labor) histogram calculated by early start and late start.

Other Reports: In addition to above reports, District may request, from month to month, any two of the following reports. Submit four (4) copies of all reports.
1. Activities by early start.
2. Activities by late start.
3. Activities grouped by Subcontractors or selected trades.
4. Activities with scheduled early start dates in a given time frame, such as fifteen (15) or thirty (30) day outlook.

Furnish District with report files on compact disks containing all schedule files for each report generated.

1.15 PROJECT STATUS REPORTING

A. In addition to submittal requirements for CPM scheduling identified in this Section, Contractor shall provide a monthly project status report (i.e., written narrative report) to be submitted in conjunction with each CPM Schedule as specified herein. Status reporting shall be in form specified below.

Contractor shall prepare monthly written narrative reports of status of Project for submission to District. Written status reports shall include:
1. Status of major Project components (percent (%) complete, amount of time ahead or behind schedule) and an explanation of how Project will be brought back on schedule if delays have occurred.
2. Progress made on critical activities indicated on CPM Schedule.
3. Explanations for any lack of work on critical path activities planned to be performed during last month.
4. Explanations for any schedule changes, including changes to logic or to activity durations.
5. List of critical activities scheduled to be performed next month.
6. Status of major material and equipment procurement.
7. Any delays encountered during reporting period.
8. Contractor shall provide printed report indicating actual versus planned resource loading for each trade and each activity. This report shall be provided on weekly and monthly basis.
a. Actual resource shall be accumulated in field by Contractor and shall be as noted on Contractor’s daily reports. These reports will be basis for information provided in computer-generated monthly and weekly printed reports.

b. Contractor shall explain all variances and mitigation measures.

9. Contractor may include any other information pertinent to status of Project. Contractor shall include additional status information requested by District at no additional cost.

10. Status reports, and the information contained therein, shall not be construed as claims, notice of claims, notice of delay, or requests for changes or compensation.

1.16 WEEKLY SCHEDULE REPORT

A. At the Weekly Progress Meeting, the Contractor shall provide and present a time-scaled three (3) week look-ahead schedule that is based and correlated by activity number to the current schedule (i.e., Initial, Original CPM, or Schedule Update).

1.17 DAILY CONSTRUCTION REPORTS

A. Daily, Contractor shall submit a daily activity report to District for each workday, including weekends and holidays when worked. Contractor shall develop the daily construction reports on a computer-generated database capable of sorting daily Work, manpower, and man-hours by Contractor, Subcontractor, area, sub-area, and Change Order Work. Upon request of District, furnish computer disk of this data base. Obtain District’s written approval of daily construction report data base format prior to implementation. Include in report:

1. Project name and Project number.
2. Contractor’s name and address.
3. Weather, temperature, and any unusual site conditions.
4. Brief description and location of the day’s scheduled activities and any special problems and accidents, including Work of Subcontractors. Descriptions shall be referenced to CPM scheduled activities.
5. Worker quantities for its own Work force and for Subcontractors of any tier.
6. Equipment, other than hand tools, utilized by Contractor and Subcontractors.

1.18 PERIODIC VERIFIED REPORTS

A. Contractor shall complete and verify construction reports on a form prescribed by the Division of the State Architect and file reports on the first day of February, May, August, and November during the preceding quarter year; at the completion of the Contract; at the completion of the Work; at the suspension of Work for a period of more than one (1) month; whenever the services of Contractor or any of Contractor’s Subcontractors are terminated for any reason; and at any time a special verified report is required by the Division of the State Architect. Refer to section 4-336 and section 4-343 of Part 1, Title 24 of the California Code of Regulations.

PART 2 – PRODUCTS - Not Used.

PART 3 - EXECUTION - Not Used.

END OF DOCUMENT
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

   1. Preconstruction photographs.

B. Related Requirements:

   1. Section 01 33 00 "Submittal Procedures" for submitting photographic documentation.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
   3. Identification: Provide the following information with each image description in file metadata tag:
      a. Name of Project.
      b. Name of Contractor.
      c. Date photograph was taken.
      d. Description of location, vantage point, and direction (by compass point).
      e. Unique sequential identifier keyed to accompanying key plan.

C. Video Recording: At the Contractor’s option, provide video recording in lieu of photographs specified in paragraph, “Preconstruction Photographs.” Submit one copy in digital video disc format acceptable to District.

   1. Identification: On each copy, provide an applied label with the following information:
a. Name of Project.
b. Name of Contractor.
c. Date videotape was recorded.

1.4 USAGE RIGHTS

A. If a professional photographer is engaged to take photographs or video recordings, obtain and transfer copyright usage rights from photographer to District for unlimited reproduction of photographic documentation.

1.5 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

B. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to District.

1.6 PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.

C. Preconstruction Photographs: Before commencement of demolition and before starting construction, take photographs that show preconstruction conditions of existing landscape materials; on-site paving; building interior finishes to include ceilings, walls and floors; and interior and exterior equipment that are to remain in place.

1. The photographs will be used to determine responsibility for damage that might appear to have been caused by construction activities. It will be the Contractor’s responsibility, through photographs, to show that damage was preexisting.

D. The number and frequency of photographs shall be as directed by the District’s Project Manager.

1. For bid purposes only, assume to provide 15 photographs every month during construction.
1.7 VIDEO RECORDINGS

A. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
2. Begin each video recording with name of Project, Contractor’s name, and Project location.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:
   1. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
   2. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   3. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   4. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.


1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
   a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:
   a. Scheduled date for first submittal.
   b. Specification Section number and title.
   c. Submittal category: Action; informational.
   d. Name of subcontractor.
   e. Description of the Work covered.
   f. Scheduled date for Architect's final release or approval.
   g. Scheduled date of fabrication.
   h. Scheduled dates for purchasing.
   i. Scheduled dates for installation.
   j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
      a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
      c. Contractor shall execute a data licensing agreement in the form of AIA document Form C106, or other agreement form acceptable to Owner and Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 10 business days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 business days for initial review of each submittal.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
   3. Include the following information for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Name of subcontractor.
      g. Name of supplier.
      h. Name of manufacturer.
      i. Submittal number or other unique identifier, including revision identifier.
         1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
      j. Number and title of appropriate Specification Section.
      k. Drawing number and detail references, as appropriate.
      l. Location(s) where product is to be installed, as appropriate.
      m. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
   a. Transmittal Form for Paper Submittals: As approved by Architect.
   b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
      1) Project name.
      2) Date.
      3) Destination (To:).
      4) Source (From:).
      5) Name and address of Architect.
      6) Name of Contractor.
      7) Name of firm or entity that prepared submittal.
      8) Names of subcontractor, manufacturer, and supplier.
      9) Category and type of submittal.
      10) Submittal purpose and description.
      11) Specification Section number and title.
      12) Specification paragraph number or drawing designation and generic name for each of multiple items.
      13) Drawing number and detail references, as appropriate.
      14) Indication of full or partial submittal.
      15) Transmittal number.
      16) Submittal and transmittal distribution record.
      17) Remarks.
E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
   a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
3. Provide means for insertion to permanently record Contractor’s review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly to web-based project software website. Enter required data in web-based software site to fully identify submittal.

2. Submit electronic submittals via email as PDF electronic files.

3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.

5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.


C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

3. Submit Shop Drawings in PDF electronic file format.
   a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.
   e. Specification paragraph number and generic name of each item.

3. Provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Architect, through Construction Manager, will retain two Sample sets; remainder will be returned.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in the following format:
      a. PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

G. Contractor’s Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."

H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

J. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

M. Installer Certificates: Submit written statements on manufacturer’s letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

N. Manufacturer Certificates: Submit written statements on manufacturer’s letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

O. Product Certificates: Submit written statements on manufacturer’s letterhead certifying that product complies with requirements in the Contract Documents.

P. Material Certificates: Submit written statements on manufacturer’s letterhead certifying that material complies with requirements in the Contract Documents.

Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency’s standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

R. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers’ names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency’s standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency’s standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES (ALSO CALLED DEFERRED SUBMITTALS)

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and two paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR’S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 “Closeout Procedures.”
C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor’s approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect and Construction Manager will not review submittals received from Contractor that do not have Contractor’s review and approval.

3.2 ARCHITECT’S AND CONSTRUCTION MANAGER’S ACTIONS

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION
SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at a testing facility to verify performance characteristics.

2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

3. Room Mockups: Mockups of typical interior spaces (such as a complete apartment or certain rooms) complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.

2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.
C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 15 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
   1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
   1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
   3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by any Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or...
defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST’s National Voluntary Laboratory Accreditation Program.

H. Manufacturer’s Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
      f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.  
      a. Allow seven days for initial review and each re-review of each mockup.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings and as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are the Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
   2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
   4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
C. Manufacturer’s Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 “Submittal Procedures.”

D. Manufacturer’s Technical Services: Where indicated, engage a manufacturer’s technical representative to observe and inspect the Work. Manufacturer’s technical representative’s services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor’s responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

   1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Delivery of samples to testing agencies.
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor’s quality-control plan. Coordinate and submit concurrently with Contractor’s construction schedule. Update as the Work progresses.
   1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 “Execution.”

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books’ “National Trade & Professional Associations of the United States.” The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
16. AIA - American Institute of Architects (The); www.aia.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bwss.org.
49. CDA - Copper Development Association; www.copper.org.
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
75. EIA - Electronic Industries Alliance; (See TIA).
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
90. GA - Gypsum Association; www.gypsum.org.
92. GS - Green Seal; www.greenseal.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
REFERENCES

HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
IAS - International Accreditation Service; www.iasonline.org.
ICBO - International Conference of Building Officials; (See ICC).
ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
IESNA - Illuminating Engineering Society of North America; (See IES).
IEST - Institute of Environmental Sciences and Technology; www.iest.org.
Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
ISSFIA - International Solid Surface Fabricators Association; (See ISFA).
ITU - International Telecommunication Union; www.itu.int/home.
KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
LMA - Laminating Materials Association; (See CPA).
MCA - Metal Construction Association; www.metalconstruction.org.
NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
NCMA - National Concrete Masonry Association; www.ncma.org.
NECA - National Electrical Contractors Association; www.necanet.org.
NFHS - National Federation of State High School Associations; www.nfhs.org.
NFPA - NFPA International; (See NFPA).
150. NLGA - National Lumber Grades Authority; www.nlga.org.
151. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
156. NSPE - National Society of Professional Engineers; www.nspe.org.
158. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
160. PCI - Precast/Prestressed Concrete Institute; www pci.org.
162. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
166. SAE - SAE International; www.sae.org.
167. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
168. SDI - Steel Deck Institute; www.sdi.org.
170. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
171. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
175. SMACNA - Sheet Metal and Air Conditioning Contractors’ National Association; www.smacna.org.
176. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
177. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
186. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
189. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
190. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
196. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
197. USAV - USA Volleyball; www.usavolleyball.org.
C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CALTRANS; State of California; Department of Transportation; www.dot.ca.gov
2. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
4. CDHS; California Department of Health Services; (See CDPH).
5. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
6. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
7. DSA; Division of the State Architect; www.dgs.ca.gov.
8. SDAPCD; San Diego Air Pollution Control district; www.sdapcd.org

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
1. Section 01 10 00 “Summary” for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. General: Refer to “Utility Usage” Article in General Conditions. Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner’s construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, temporary fencing and gates, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of authorities having jurisdiction.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and CBC.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

B. Wood Enclosure Fence: Plywood, 8 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

C. Polyethylene Sheet: Reinforced, fire-resistant sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

D. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Obtain Construction Manager's approval of location of all temporary offices, trailers and sheds before placing them.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
   1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
   2. Conference room of sufficient size to accommodate meetings of 8 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
   3. Drinking water and private toilet.
   5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
   6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Inspector's Field Office: Provide as specified in Article 46 of the General Conditions.
D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
   1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Construction Manager authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   3. Permanent HVAC System: If Construction Manager authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 77 00 "Closeout Procedures".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
   1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on
completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Install lighting for Project identification sign (Sign provided by the Owner.)
   3. Install lighting for fire hydrant identification signs located on temporary site enclosure fencing.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.
   1. Provide additional telephone lines for the following:
      a. Provide a dedicated telephone line for each facsimile machine in each field office.
   2. At each telephone, post a list of important telephone numbers.
      a. Police and fire departments.
      b. Ambulance service.
      c. Contractor's home office.
      d. Contractor's emergency after-hours telephone number.
      e. Architect's office.
      f. Owner's office.
      g. Principal subcontractors' field and home offices.
   3. Provide superintendent with cellular telephone for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Maintain support facilities until Construction Manager schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Provide temporary parking areas for construction personnel, as approved by Owner and Construction Manager.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.

E. Project Signs: Provide Project signs as approved by Owner. Unauthorized signs are not permitted.
   1. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
      a. Provide temporary, directional signs for construction personnel and visitors.
   2. Maintain and touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal.”
G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent. See requirements on Civil Engineering Drawings and in Section 311000 "Site Clearing."

D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to Civil drawings and Construction General Permit or authorities having jurisdiction, whichever is more stringent.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
   2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
   3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
   4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

G. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
   1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations. Comply with approved site plan submitted per this Section.
   2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
   4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL


B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
   1. Protect porous materials from water damage.
   2. Protect stored and installed material from flowing or standing water.
   3. Keep porous and organic materials from coming into prolonged contact with concrete.
   4. Remove standing water from decks.
   5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
   1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
   2. Keep interior spaces reasonably clean and protected from water damage.
   3. Periodically collect and remove waste containing cellulose or other organic matter.
   4. Discard or replace water-damaged material.
   5. Do not install material that is wet.
   6. Discard, replace, or clean stored or installed material that begins to grow mold.
   7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
   1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
   2. Use permanent HVAC system to control humidity.
   3. Comply with manufacturer’s written instructions for temperature, relative humidity, and exposure to water limits.
      a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
      b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
   3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION
SECTION 01 56 39
TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Preserve, protect, and prune as necessary existing trees and shrubs, and other vegetation indicated to remain.

B. All trees and plant materials to remain on site shall be protected from all trades working on the job, and it shall be the Contractor's responsibility to ensure that all subcontractors are aware of and held responsible for any damage to existing trees and plant material. In addition, Contractor shall be held responsible to ensure that following protective measures are carried out throughout the entire construction period.

C. Maintenance: Throughout the life of the construction project, the Contractor shall be responsible for overseeing the watering, fertilizing, pruning, and other measures necessary to protect all existing trees, lawns, shrubs, groundcover and other plants.

D. Related Documents
1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

E. Related sections
1. 03 30 00 Cast-in-place Concrete
2. 31 10 00 Site Clearing
3. 31 20 00 Earth Moving
4. 32 12 16 Asphalt Paving
5. 32 13 13 Concrete Paving
6. 32 13 16 Decorative Concrete Paving
7. 32 80 00 Irrigation System
8. 32 90 00 Landscaping
9. 33 41 00 Storm Drainage

F. References: The following specifications and standards of the organizations and documents listed in this paragraph form a part of the specification to the extent required by the references thereto. If the requirements of the following referenced standards and specification conflict with this specification section, the requirements of this specification shall prevail. If the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail.

1.2 VERIFICATION

A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities and shall immediately inform
the Construction Manager of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given approval to do so by the Construction Manager.

1.3 QUALITY ASSURANCE

A. Arborist: Contractor shall engage and pay a Certified Arborist who will be responsible for supervising implementation of tree and plant protection measures specified in this Section.
   1. Arborist shall be subject to acceptance by Construction Manager.
   2. Arborist registered by the American Society of Consulting Arborists.
   3. Submit evidence contract with acceptable Certified Arborist prior to commencing site mobilization activities.

PART 2 PRODUCTS

2.1 MULCH

A. Mulch shall be coarse, ground, from tree and woody brush sources. The minimum range of fine particles shall be 3/8 inch or less in size and a maximum size of individual pieces shall be approximately 1 to 1-1/2 inch in diameter and maximum length of approximately 2 to 4 inches. No more than 25% of the total volume shall be fine particles and no more than 20% of total volume be large pieces.
   1. It is understood that mulch quality will vary significantly from supplier to supplier and region to region. The above requirements may be modified to conform to the source material from locally reliable suppliers as approved by the Construction Manager.

2.2 BARRIERS

A. PLASTIC MESH FENCE: Heavy-Duty orange plastic mesh fencing fabric 48 inches wide. Fencing shall be attached to metal “U” or “T” post driven into the ground of sufficient depth to hold the fabric solidly in place without sagging. The fabric shall be attached to the post using attachment ties of sufficient number and strength to hold up the fabric without sagging. The Construction Manager may request, at any time, additional post, deeper post depths and or additional fabric attachments if the fabric begins to sag, lean or otherwise not present a sufficient barrier to access.

B. CHAIN LINK FENCE: 6 feet tall metal chain link fence set in metal frame panels on movable post of sufficient size to hold the fence erect in areas of existing paving to remain.

C. GATES: For each fence type and in each separate fenced area, provide a minimum of one 3-foot-wide gate. Gates shall be lockable. The location of the gates shall be approved by the Construction Manager.

D. Submit supplier’s product data that meets the requirements for approval.

2.3 TREE PROTECTION SIGN

A. Heavy-duty cardboard or plastic signs, 8.5 inches’ x 11 inches, white colored background with black 2-inch-high or larger letters in block type. The signs shall be attached to the tree protection fence every 50 feet o.c. The tree protections sign shall read, “Tree and Plant Protection Area- Keep Out”.

2.4 FERTILIZER

A. Unless otherwise directed by Construction Manager, type and quantity of fertilizer shall be determined by soil agronomist engaged and paid by Contractor, who is acceptable to Construction Manager.
   1. As basis for bidding, fertilizer shall be Romeo “Greenbelt” 22-14-14 tree fertilizer or approved equal at 4 lb. fertilizer dissolved in 100 gallons’ water.

2.5 ACCESSORY MATERIALS

A. As determined by Contractor as necessary for sustained health of trees and plants, subject to
acceptance by Construction Manager. Accessory materials shall include mulch, tree and plant stakes and temporary covers.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protection: Prior to construction activities, especially demolition and excavation, on the site, Contractor shall submit to Construction Manager evidence of a contract with a Certified Arborist who shall be responsible for supervising implementation of the following tree protection measures.

1. Protect all existing trees, shrubs and ground covers from stockpiling, material storage including soil, vehicle parking and driving within the tree drip line. Restrict foot traffic to prevent excessive compacting of soil over root systems.

2. Protect root systems of existing trees, shrubs, and ground covers from damage due to chemically injurious materials in solution caused by runoff and spillage during mixing, placement of construction materials, and drainage from stored materials.

3. Protect root system from flooding, erosion, excessive wetting and drying resulting from de-watering and other operations.

4. Above-ground surface runoff shall not be directed into the tree canopy area from adjacent areas. Ensure that sidewalks or other construction do not trap water near the tree. Coordinate with requirements specified in Section 015700 - Temporary Controls.

5. Protect existing plant materials from unnecessary cutting, breaking and skinning of roots and branches, skinning and bruising of bark.

6. Use no soil sterilant under pavement near existing trees.

7. Do not allow fires under and adjacent to existing trees or plants.

B. Maintenance: Throughout duration of the Contract, Contractor shall be responsible for irrigation, fertilizing, pruning, and other measures necessary to protect and nurture all existing trees, plants, ground covers and lawns indicated to remain in Project.

3.2 PRUNING

A. Engage approved Arborist, registered by the American Society of Consulting Arborists. Contact Construction Manager for contact information. Arborist shall direct removal of branches from trees and large shrubs, and correctional pruning and cabling of specified trees that are to remain, if required to clear new construction and where indicated. Arborist shall also direct necessary tree root pruning and relocation work.

B. Where indicated by Construction Manager, extend pruning operation to restore natural shape of entire tree using only Western Chapter ISA Pruning Standards.

C. Cut branches and roots with sharp pruning instruments. Do not break, chop, or mutilate.

D. Pruning of existing trees shall concern itself with removing all dead wood 1/2” or greater in size, removing vines and/or sucker growth. Tree cavities existing on all oak trees are to be cleaned of wood rot. The procedure for each tree may vary and will need to be approved by the Consulting Arborist prior to commencing work.

E. Tree limbs in the way of proposed buildings shall only be trimmed by reputable ISA Certified Arborist or ISA Certified Climber and shall approved by Construction Manager.

3.3 IRRIGATION

A. Water trees and other vegetation that are to remain as necessary to maintain their health before, during and after the course of the work as directed by the Consulting Arborist. Maintain a water schedule and document. Submit schedule to Construction Manager.

B. All trees shall be deep root watered using an injection needle to a depth of eighteen (18) inches. Needle shall be inserted into the ground five (5) feet apart in concentric rings around the tree; each ring is four (4) feet wider than the previous one. This process shall continue out to the drip line of the tree.
C. Trees greater than twelve (12) inches in caliper shall be watered during the first month of construction using 1,200 gallons of water per tree. For trees less than twelve (12) inches in caliper, 800 gallons of water shall be used per tree. This procedure shall be repeated every six months, in addition to the normal watering schedule.

3.4 FERTILIZING
A. All trees shall be fertilized before, during, and after construction by pumping under pressure directly 18-inches into root zone as directed by Certified Arborist.

3.5 EXCAVATION AROUND TREES
A. Excavate within drip lines of trees only where indicated.
B. Where trenching for utilities is required within drip lines, tunnel under and around roots of 2 1/2" diameter or larger by hand digging. Do not cut main lateral roots that are 2" or larger. Cut smaller roots that are smaller than 2" which interfere with installation of new work. Use sharp approved pruning tools. Pipes should be routed into an alternate location to avoid conflict, wherever possible.
C. Where excavating for new construction is required within drip lines of trees, hand excavate to minimize damage to root systems. Use narrow tine spading forks and comb soil to expose roots. Relocate roots in backfill areas wherever possible. If large, main lateral roots are encountered, expose beyond excavation limits as required to bend and relocate without breaking.
D. If encountered immediately adjacent to location of new construction and relocation is not practical, cut roots approximately six (6) inches back from new construction. Cover cut ends with plastic sandwich bag.
E. Do not allow exposed roots to dry out before permanent backfill is placed. Provide temporary earth cover, pack with wet peat moss or four (4) layers of wet untreated burlap and temporarily support and protect from damage until permanently relocated and covered with backfill. Water to eliminate voids and air pockets.
F. Thin branching structure in accordance with Western Chapter, ISA Pruning Standards to balance loss to root system caused by damage or cutting of root system. Thinning shall not exceed 30% of existing branching structure.

3.6 GRADING AND FILLING AROUND TREES
A. Maintain existing grade within drip line of trees unless otherwise indicated. Any grade change shall be limited to six (6) inches of cut or fill from the original grade and shall be accomplished by hand. Under all Quercus and Pinus trees there shall be no grade change under at least the inner 50% of the tree canopy.
B. Lowering Grades: where existing grade is above new finish grade shown around trees, carefully hand excavate within drip line to new grade. Cut roots exposed by excavation to approximately three (3) inches below elevation of new finish grade.
C. Raising Grades: permitted only as acceptable to Construction Manager.
D. If building pads or foundations are to be constructed within the fenced areas or if the existing landscape is to be altered by the addition of fill or reduced by excavation, the Construction Manager shall be notified prior to this work. Measures as approved by the Construction Manager, such as small retaining walls or subgrade aeration lines, may be required to mitigate construction procedures affecting the tree.

3.7 REPAIR AND REMOVAL OF TREES
A. Repair and Removal of Trees: Certified Arborist and Construction Manager will determine whether trees shall be restored or removed. Treat and restore trees damaged by construction operations in a manner acceptable to Construction Manager. Perform restoration and pruning promptly after damage occurs to prevent progressive deterioration of damaged trees. If trees...
cannot be restored, equitable adjustment to Contract Sum shall be made to compensate the College for loss, in accordance with the Contract General Conditions.

1. Remove dead and damaged trees that are determined by Certified Arborist to be incapable of restoration to normal growth pattern.

2. Contractor shall be liable for all damage and necessary restoration actions to existing trees, including trunk, branches, or roots. Restoration shall be performed under direction of Certified Arborist.

3.8 REPAIR AND REPLACEMENT OF SHRUBS AND GROUND COVER

A. Repair shrubs and other vegetation damaged by construction operations in a manner acceptable to Construction Manager. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged plant.

B. Remove and replace all dead and damaged plants that are determined by the Construction Manager to be incapable of restoration to normal growth pattern.
   1. Provide new shrubs of same size and species as those replaced or as acceptable to the Construction Manager.
   2. Plant and maintain as specified under Division 32.

C. Repairs and Replacements of Shrubs and Ground Cover: Repair shrubs and other vegetation damaged by construction operation in manner acceptable to Construction Manager.
   1. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged plant. Remove and replace all dead and damaged plants up to six-inch diameter, which are determined by Construction Manager as being incapable of restoration to normal growth pattern.
   2. Provide new shrubs of same size and species as those replaced or as acceptable to the Construction Manager.

3.9 COMPENSATION TO COLLEGE’S FOR LOST AND DAMAGED TREES

A. The Contractor shall be liable for the loss in value to damaged trees and for all repair or replacement costs resulting from construction operations as determined by the Construction Manager. Because of the irreplaceable nature of many of the existing trees, the amount of assessment shall be determined by the Construction Manager, depending upon tree species, condition before damage, and location value.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary irrigation of trees and landscape, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities and facilities include, but are not limited to, the following:
   1. Irrigation backflow devices
   2. Water service and distribution.
   3. PVC irrigation pressurized mainlines and non-pressurized laterals
   4. Irrigation valves and valve boxes
   5. Electric power service to irrigation controller.
   6. Controller and low voltage wiring
   7. Irrigation spray and rotor sprinklers

C. Security and protection facilities include, but are not limited to, the following:
   1. Irrigation operation and control

D. Reserved

E. Related Sections include the following:
   1. Section for: Submittal Procedures
   2. Section for: Temporary Facilities and Control
   3. Section for: Tree and Plant Protection
   4. Section for: Irrigation System

1.2 SUBMITTALS

A. Temporary Facility Report: Submit one (1) report of inspection of existing conditions, temporary erection of mainlines, connection of existing irrigation and performance adjustment of irrigation system.

B. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor’s Construction Schedule, submit a schedule indicating implementation and termination of the temporary irrigation system.

1.3 PROJECT CONDITIONS

A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
   1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner’s acceptance, regardless of previously assigned responsibilities.

B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
   1. Keep temporary services and facilities clean and neat.
   2. Relocate temporary services and facilities as required by progress of the Work.
PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by the Construction Manager. Provide materials suitable for use intended.

B. All material required to fulfill this section shall comply to section 32 80 00 – part 2 for all new material and equipment.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY AND FACILITY INSTALLATION

A. General:
1. Arrange with utility company, Construction Manager for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

3.3 SUPPORT FACILITIES INSTALLATION

A. The Contractor, Architect and Construction Manager shall schedule a meeting to review existing landscape and the irrigation system that will be affected by the scope of this contract.

B. General: Comply with the following:
1. Review and coordinate location and alignment of below grade and above grade pressurized main.
2. Coordinate location of relocated valve manifolds and lateral lines with Architect.
3. Renovate, clean and test all valves within the affected scope of work. Replace worn valve bonnets and install new accuator solenoids.
4. Replace worn or damaged valve boxes and install per plan details.
5. Maintain controller automation of existing valves either through existing controller or battery controller devices.
7. Connect new mainline and point –of –connection to existing manifolds once new facility installtion is complete.
8. Connect existing remote control valves within the scope of this work to existing central control system per section 32 80 00

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of
noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

3.5  OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by construction activities.

C. Termination and Removal: Remove temporary irrigation facility when need for its service has ended, when it has been replaced by permanent irrigation system connection, or no later than Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers’ standard warranties on products; special warranties; and comparable products.

B. Related Requirements:
   1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
   2. Section 01 25 13 "Substitution Procedures" for requests for substitutions.
   3. Section 01 42 00 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
   2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."

b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.


1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. This article eliminates need to include this information in each Section. Limit use of this article in each Section to unusual requirements.

B. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

C. Delivery and Handling:
   Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   1. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   2. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   3. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

D. Storage:
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weather-tight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   6. Protect stored products from damage and liquids from freezing.
   7. Delete subparagraph below if Owner provides own storage facilities.
   8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

   1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
   3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:
   1. Sole Source Items: Where products on the Sole Source Items list are specified, only the manufacturer and model on the list shall be provided. These are District Board approved items for sole sourcing. The list is as follows.

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<thead>
<tr>
<th>Sole Source Part 1, Board Approved 10/18/2018</th>
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<tbody>
<tr>
<td><strong>Sole Source #</strong></td>
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**Sole Source Part 2, Board Approved 04/18/2018**

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**Sole Source Part 3, Board Approved 05/16/2019**

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<td>Wet Barrel Fire Hydrant</td>
<td>Clow</td>
<td>21 11 00</td>
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2. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

3. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

4. Products:
   a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

5. Manufacturers:
   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

6. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within the specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 13 “Product Options and Substitutions” for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION
SECTION 01 73 00
EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Coordination of Owner-installed products.
   6. Progress cleaning.
   7. Starting and adjusting.
   8. Protection of installed construction.

B. Related Requirements:
   1. Section 01 10 00 "Summary" for limits on use of Project site.
   2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
   3. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor or professional engineer.

B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal (if any found and transported).

D. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.

E. Final Property Survey: Submit six copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements, after originally installed.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Mechanical systems piping and ducts.
   f. Control systems.
   g. Communication systems.
   h. Fire-detection and -alarm systems.
   i. Conveying systems.
   j. Electrical wiring systems.
   k. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Sprayed fire-resistive material.
   d. Equipment supports.
   e. Piping, ductwork, vessels, and equipment.
   f. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Section, include the following:
   1. Description of the Work.
   2. List of detrimental conditions, including substrates.
   3. List of unacceptable installation tolerances.
   4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."
3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a licensed land surveyor or professional engineer to lay out the Work using accepted surveying practices.
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Establish limits on use of Project site.
   3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   4. Inform installers of lines and levels to which they must comply.
   5. Check the location, level and plumb, of every major element as the Work progresses.
   6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
   7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect and Owner. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of three permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of new construction and sitework.

E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 UTILITY INTERRUPTIONS AND SHUT-DOWNS
A. All existing utilities (water, sewer, gas, mechanical, electrical, low voltage / information technology telecommunications, fire alarm system, security, etc.) to active campus facilities and/or infrastructure shall not be interrupted during campus operations. All required utility (water, sewer, gas, mechanical, electrical, telecommunications, fire alarm system, security, etc.) shutdowns will require one (1) week minimum prior written notice and require coordination with existing campus operations. If any and/or all utility shutdowns are required to be performed off-hours or over the weekend Contractor will be required to do so at no additional cost to the owner. Furthermore, if any and/or all utility shutdowns require temporary provisions to maintain service Contractor will be required to do so at no additional cost to the owner.

3.6 INSTALLATION
A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.7 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.8 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for construction personnel retained under separate contracts with the Owner. Verify work to be done by the Owner at Pre-construction meeting.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.9 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 and local City ordinances for removal of combustible waste materials and debris.
   2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.
   4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 “Construction Waste Management and Disposal.”

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.10 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements specified in Divisions 21 through 28.

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer’s Field Service: Comply with qualification requirements in Section 01 40 00 “Quality Requirements.”

3.11 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer’s written instructions for temperature and relative humidity.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 01 81 13 “Sustainable Design Requirements – LEED”
2. Section 31 10 00 "Site Clearing " for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of a minimum 75 percent by weight or volume of total non-hazardous solid waste generated by the Work. Calculations can be by weight or volume, but must be consistent throughout. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction
and demolition waste from landfills and incinerators. Diverted materials must include at least four material streams. Facilitate recycling and salvage of materials, including the following:  

1. **Demolition Waste:** Exclude excavated soils and land-clearing debris. Paving materials may be included. Include materials destined for alternative daily cover (ADC) in the calculation as waste (not diversion).
   a. Asphalt paving.
   b. Concrete.
   c. Concrete reinforcing steel.
   d. Concrete masonry units.
   e. Wood studs.
   f. Plywood and oriented strand board.
   g. Wood trim.
   h. Structural and miscellaneous steel.
   i. Rough hardware.
   j. Roofing.
   k. Insulation.
   l. Doors and frames.
   m. Door hardware.
   n. Glazing.
   o. Metal studs.
   p. Gypsum board.
   q. Acoustical tile and panels.
   r. Carpet.
   s. Equipment.
   t. Cabinets.
   u. Plumbing fixtures.
   v. Piping.
   w. Supports and hangers.
   x. Valves.
   y. Sprinklers.
   z. Mechanical equipment.
   aa. Refrigerants.
   bb. Electrical conduit.
   cc. Wiring.
   dd. Lighting fixtures.
   ee. Lamps.
   ff. Ballasts.
   gg. Electrical devices.

2. **Construction Waste:**
   a. Masonry and CMU.
   b. Lumber.
   c. Wood sheet materials.
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Carpet and pad.
   i. Gypsum board.
   j. Piping.
   k. Electrical conduit.
   l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Prior to starting construction a Waste Management Plan shall be provided to Architect and Owner, that confirms where materials will be collected, staged, handled, and/or picked up from the Campus. Submit plan within 15 days of date established for the Notice of Award.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Owner’s Waste Disposal and Diversion Reporting Form (See Supplemental Conditions). Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons.
   4. Quantity of waste salvaged, both estimated and actual in tons.
   5. Quantity of waste recycled, both estimated and actual in tons.
   6. Total quantity of waste recovered (salvaged plus recycled) in tons.
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. LEED Sustainable Design Submittal: Submit documentation to Owner, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Respond to questions and requests from Owner regarding construction waste management and disposal until the Owner has made its determination on the Project's LEED self-certification. Document correspondence with Owner as informational submittals.

F. Qualification Data: For waste management coordinator.

G. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

H. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-
Accredited Professional. Waste management coordinator may also serve as LEED coordinator.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to the LEED and CalGreen (Green Building) Code requirements. Plan shall consist of waste identification and waste reduction work plan. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Owner’s Waste Disposal and Diversion Reporting Form (See Supplemental Conditions). Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

C. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 “Temporary Facilities and Controls.”

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
1. Distribute waste management plan to everyone concerned within five days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Comply with Section 015000 “Temporary Facilities and Controls” for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

E. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

F. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan. Co-mingling of recyclable waste shall be allowed if allowed by recycling or reuse facility.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from construction area.
   4. Store components off the ground and protect from the weather.

3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
   1. Clean Gypsum Board: If gypsum board will be processed on-site, grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
D. Paint: Seal containers and store by type.

3.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.
   5. Repair of the Work.

B. Related Requirements:
   1. Section 01 73 00 "Execution" for progress cleaning of Project site.
   2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   4. Section 01 79 00 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance (extra stock) material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number where applicable.
   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Construction Manager's signature for receipt of submittals.
5. Submit test/adjust/balance records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions. Deliver all keys that operate doors and other equipment.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders (Fire Department and Health Department).
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect and Construction Manager will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect and Owner, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.
1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to Payment Procedures in the General Conditions.
   2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect and Construction Manager will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A or other Architect-approved form.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding to room numbers in chronological order.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect and Construction Manager.
      d. Name of Contractor.
      e. Page number.
   4. Submit list of incomplete items in the following format:
      a. Web-based project management software upload. Utilize software feature for creating and updating list of incomplete items (punch list).
      b. Two paper copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   g. Sweep concrete floors broom clean in unoccupied spaces.
   h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
   i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
   j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment, irrigation equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.


o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare a written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
   a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Product maintenance manuals.
   5. Systems and equipment maintenance manuals.

B. Related Requirements:
   1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Section 01 77 00 "Closeout Procedures" for schedule for submitting Operation and Maintenance documentation.
   3. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
   1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:
   1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect. Submit by uploading to web-based project software site.
      a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      b. Enable inserted reviewer comments on draft submittals.
   2. Two paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect, through Construction Manager, will return one reviewed and edited copy. Submit in binders as per Paragraph 2.2F.
C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
2. Table of contents.

B. Title Page: Include the following information:
1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
   2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
   1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
2. Flood.
5. Power failure.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
   1. Upon prior approval of Architect and Owner, this Product Maintenance Manual may be combined with Systems and Equipment Maintenance Manual(s) to be one overall manual.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual’s table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer’s name.
   3. Color, pattern, and texture.
   5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer’s written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers’ maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
   1. Upon prior approval of Architect and Owner, this Systems And Equipment Maintenance Manual may be combined with Product Maintenance Manual to be one overall manual.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual’s table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service
agent, and cross-reference Specification Section number and title in Project Manual and
drawing or schedule designation or identifier where applicable.

C. Manufacturers’ Maintenance Documentation: Manufacturers’ maintenance documentation
including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly
and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential
maintenance procedures:
1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of
required lubricants for equipment, and separate schedules for preventive and routine
maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly,
quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers’ forms for recording
maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with
parts identified and cross-referenced to manufacturers’ maintenance documentation and local
sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and
telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and
conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides
an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures
for use by emergency personnel and by Owner's operating personnel for types of emergencies
indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care
and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance
data indicating operation and maintenance of each system, subsystem, and piece of equipment
not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information
for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of operation and maintenance manuals.
   2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 "Project Record Documents."

G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Miscellaneous record submittals.

B. Related Requirements:
   1. Section 01 73 00 “Execution” for final property survey.
   2. Section 01 77 00 “Closeout Procedures” for general closeout procedures.
   3. Section 01 78 23 “Operation and Maintenance Data” for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set of marked-up record prints.
      a. Initial Submittal:
         1) Submit PDF electronic files of scanned record prints.
         2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting/markups are acceptable.
      b. Final Submittal:
         1) Submit PDF electronic files of the scanned record prints. Verify format with Architect and Construction Manager.
         2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and one annotated PDF electronic file of Project's Specifications, including addenda and contract modifications.

C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

D. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.
PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
   e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location. Erasable pencil is used in case changes or corrections need to be made.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Refer instances of uncertainty to Architect for resolution.
   a. See Section 01 33 00 "Submittal Procedures" for requirements related to use of Architect's digital data files.
b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect and Construction Manager.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
B. Format: Submit miscellaneous record submittals as PDF electronic file and one paper copy.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

2.1 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file OR scanned PDF electronic file(s) of marked-up paper copy of Product Data.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION
SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 78 23 “Operation and Maintenance Data”

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors’ names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit three copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Architect.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Date of video recording.
   2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
   3. Transcript (Contractor's Option to above method): Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals OR in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
   3. Review required content of instruction.
   4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.
PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test, or a demonstration.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
   1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
   2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
   3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
   4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
      a. Name of Contractor/Installer.
b. Business address.
c. Business phone number.
d. Point of contact.
e. E-mail address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
   a. Produce segments to present a single significant piece of equipment per segment.
   b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
   c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Pre-produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION
SECTION 01 81 13
SUSTAINABLE DESIGN REQUIREMENTS - LEED v4 BD+C

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This project is not pursuing green building certification with the U.S. Green Building Council (USGBC) but has been designed using best practice strategies for green building and energy efficiency to achieve a LEED certification level of Gold.

B. Section includes general requirements and procedures for compliance with certain prerequisites and credits needed for Project to obtain "LEED Version 4 for Building Design and Construction" (LEED v4 BD+C) Gold certification based on USGBC's LEED v4 BD+C.
   1. Specific requirements for LEED are also included in other Sections.
   2. Some LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
   3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
      a. Some LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.

1.3 DEFINITIONS

A. LEED: USGBC's "LEED Version 4 for Building Design and Construction."
   1. Definitions that are a part of "LEED Version 4 for Building Design and Construction" (LEED v4 BD+C) apply to this Section.

B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001. Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

C. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

D. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
   1. "Postconsumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
   2. "Preconsumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials, such as rework, regrind, or scrap, generated in a process and capable of being reclaimed within the same process that generated it.
1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at location determined by Owner. Review LEED requirements and action plans for meeting requirements.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Submit documentation to Owner and respond to questions and requests from Owner regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the Owner has made its determination on the Project's LEED self-certification.
   1. Document correspondence with Owner as informational submittals.

1.6 ACTION SUBMITTALS

A. General: Submit additional sustainable design submittals required by other Specification Sections.

B. Sustainable design submittals are in addition to other submittals.
   1. If submitted item is identical to that submitted to comply with other requirements, include an additional copy with other submittal as a record copy of compliance with indicated LEED requirements instead of separate sustainable design submittal. Mark additional copy "Sustainable design submittal."

C. Sustainable Design Documentation Submittals:
   1. Environmental Product Declarations complying with LEED requirements.
   2. Documentation for products that comply with LEED requirements for Multi-Attribute Optimization.
      a. Include documentation for regional materials, indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material and costs of regional materials.
   3. Sustainability reports for products that comply with LEED requirements for Raw Material And Source Extraction Reporting.
   4. Documentation for products that comply with LEED requirements for Leadership Extraction Practices. Include at least one of the following:
      a. Product data and certification letter from product manufacturers, indicating participation in an extended producer responsibility program and statement of costs.
      b. Product data and certification for bio-based materials, indicating that they comply with requirements. Include statement of costs.
      d. Receipts for salvaged and refurbished materials used for Project, indicating sources and costs.
      e. Product data and certification letter from product manufacturers, indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement of costs.
      f. Documentation for regional materials, indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material and costs of regional materials.
   5. Material ingredient reports for products that comply with LEED requirements for Material Ingredient Reporting.
   6. Documentation for products that comply with LEED requirements for Material Ingredient Optimization.
   7. Documentation for products that comply with LEED requirements for Product Manufacturer Supply Chain Optimization.
      a. Include documentation for regional materials, indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material and costs of regional materials.
8. Documentation complying with Section 01 74 19 "Construction Waste Management and Disposal."

9. Product data for adhesives and sealants used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.

10. Product data for paints and coatings used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.

11. Laboratory test reports for flooring, indicating compliance with requirements for low-emitting materials.

12. Laboratory test reports for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials.

13. Laboratory test reports for ceilings, walls, and thermal insulation, indicating compliance with requirements for low-emitting materials.

14. Construction Indoor-Air-Quality (IAQ) Management:
   a. Construction IAQ management plan.
   b. Product data for temporary filtration media.
   c. Product data for filtration media used during occupancy.
   d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

15. IAQ (Indoor Air Quality) Assessment:
   a. Signed statement describing the building air flush-out procedures, including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
   b. Product data for filtration media used during flush-out and occupancy.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For LEED coordinator.

B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
   1. Plumbing.
   2. Mechanical.
   3. Electrical.
   4. Specialty items, such as irrigation system and equipment.

C. Sustainable Design Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed, indicating how the following requirements will be met:
   1. List of proposed products with Environmental Product Declarations.
   2. List of proposed products complying with requirements for multi-attribute optimization.
   3. List of proposed products complying with requirements for raw material and source extraction reporting.
   4. List of proposed products complying with requirements for leadership extraction practices.
   5. List of proposed products complying with requirements for material ingredient reporting.
   6. List of proposed products complying with requirements for material ingredient optimization.
   7. List of proposed products complying with requirements for product manufacturer supply chain optimization.
   8. Waste management plan complying with Section 01 74 19 "Construction Waste Management and Disposal."

D. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with sustainable design action plans.
1.8 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-accredited professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to these LEED credits, the Contractor shall provide additional materials and procedures necessary to obtain LEED credits indicated.

B. At least 20 different products from at least five different manufacturers shall have Environmental Product Declarations (EPD) that comply with LEED requirements.

C. At least 50 percent, by cost, of the permanently installed products for the Project shall comply with LEED requirements for multi-attribute optimization.

D. At least 20 different products from at least five different manufacturers shall have publically released reports that comply with LEED requirements for Raw Material Source And Extraction Reporting.

E. Achieve two of the following:
   1. At least 20 different products from at least five different manufacturers shall comply with LEED requirements for Material Ingredient Reporting.
   2. At least 25 percent, by cost, of the permanently installed products for the Project shall comply with LEED requirements for Material Ingredient Optimization.
   3. At least 25 percent, by cost, of the permanently installed products for the Project shall comply with LEED requirements for Product Manufacturer Supply Chain Optimization.

F. Not less than 25 percent of building materials, by cost, shall comply with LEED requirements for Leadership Extraction Practices.

2.2 LOW-EMITTING MATERIALS

A. Paints and Coatings: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 50 g/L.
   3. Dry-Fog Coatings: 150 g/L.
   4. Primers, Sealers, and Undercoaters: 100 g/L.
   5. Rust-Preventive Coatings: 100 g/L.
   6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Clear Wood Finishes, Varnishes: 275 g/L.
   9. Clear Wood Finishes, Lacquers: 275 g/L.
   10. Floor Coatings: 50 g/L.
   11. Shellacs, Clear: 730 g/L.
   12. Shellacs, Pigmented: 550 g/L.
   13. Stains: 100 g/L.

B. Paints and Coatings: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
C. Adhesives and Sealants: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesives: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesives: 100 g/L.
18. Structural Wood Member Adhesives: 140 g/L.
19. Single-Ply Roof Membrane Adhesives: 250 g/L.
20. Special-Purpose Contact Adhesives (That Are Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
21. Top and Trim Adhesives: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesives: 850 g/L.
30. Special-Purpose Aerosol Adhesives (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.
34. Single-Ply Roof Membrane Sealants: 450 g/L.
35. Other Sealants: 420 g/L.
36. Sealant Primers for Nonporous Substrates: 250 g/L.
37. Sealant Primers for Porous Substrates: 775 g/L.
38. Modified Bituminous Sealant Primers: 500 g/L.
39. Other Sealant Primers: 750 g/L.

D. Adhesives and Sealants: For field applications that are inside the weatherproofing system, 90 percent of adhesives and sealants shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Flooring: Flooring shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Composite Wood: Composite wood, agrifiber products, and adhesives shall be made using ultralow-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
G. Ceilings, Walls, and Thermal Insulation: Ceilings, walls, and thermal insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

**PART 3 - EXECUTION**

3.1 NONSMOKING BUILDING

A. Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Comply with Section 01 74 19 "Construction Waste Management and Disposal."

3.3 CONSTRUCTION IAQ MANAGEMENT

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
   1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 01 50 00 "Temporary Facilities and Controls," install MERV 8 filter media at each return-air inlet for the air-handling system used during construction.
   2. Replace air filters immediately prior to occupancy.

3.4 IAQ ASSESSMENT

A. Flush-Out:
   1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14,000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
   2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside-air rate, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft./sq. ft. of outside air has been delivered to the space.
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### Totals

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110 points

END OF SECTION
SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

B. The following systems/equipment shall be commissioned:

1. Division 07 and 08: Building Enclosure Systems – Building Total Air Leakage Test and Rooftop Standing Water Test.
2. Division 22: Plumbing Systems
3. Division 23: HVAC Equipment, Building Automation System (BAS)

C. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning project. Commissioning is essentially a quality management process of observing and documenting that the equipment and systems operate and perform as intended.

D. The commissioning testing shall be based upon the following reference standards: Building Commissioning Association (www.bCxA.org); ASHRAE Guideline 0-2005, The Commissioning Process.

E. Commissioning shall be completed in accordance with all applicable local codes. For this project adhere to the following codes:

1. Title-24 Part 6 – California Energy Code (CEC)
2. Title-24 Part 11 – California Green Buildings Standards (CALgreen)
3. LEED V4 Fundamental and Enhanced Commissioning including Monitoring-Based Commissioning and Building Enclosure Commissioning (Option 1, Path 2 and Option 2)

1.2 DEFINITIONS

A. Abbreviations: The following are common abbreviations:

1. A/E: Architect / Engineer
2. ASHRAE: American Society of Heating, Refrigeration, and Air-Conditioning Engineers
3. BAS: Building Automation System
4. BMS: Building Management System
5. BOD: Basis of Design
6. CD: Construction Documents
7. CM: Construction Manager
8. CO: Certificate of Occupancy
9. CFR: Current Facilities Requirements
10. Cx: Commissioning
11. CxA: Commissioning Authority
12. CxA: Commissioning Plan
13. DD: Design Development
14. EC: Electrical Contractor
15. FDD: Fault Detection and Diagnostics
16. FPT: Functional Performance Test
17. GC: General Contractor
18. GMC: Gilbert, Mathers & Conway
19. IES: Illuminating Engineering Society
20. IST: Integrated Systems Test
21. MBCx: Monitoring-Based Commissioning
22. MEP: Mechanical, Electrical & Plumbing
23. O&M: Operation and Maintenance
24. OSHPD: Office of Statewide Health Planning and Development
25. OPR: Owner’s Project Requirements
26. PFC: Pre-Functional Checklist
27. PM: Project Manager
28. PTP: Point-to-Point
29. RACI: Responsible, Approves, Contributes, Informed
30. SD: Schematic Design
31. SOO: Sequence of Operations
32. SUR: Startup Report
33. TAB: Test, Adjust and Balance
34. TCO: Temporary Certificate of Occupancy
35. VFD: Variable Frequency Drive

B. BOD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Commissioning Plan (CxA): A document that outlines the organization, roles, responsibilities, schedule, and documentation requirements of the commissioning process.

D. PFC: Checklist created by the CxA and used by the construction team to manage quality of installation and start-up processes while ensuring all testing prerequisites are completed prior to the CxA onsite test witnessing effort.

E. FPT: Test that verifies the proper operation and performance of equipment or system. Tests require operation under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system’s sequences of operation and components are verified to be responding as the sequences state.

F. In-Warranty Walk-Through: An on-site meeting to review the building operation prior to expiration of equipment warranties (typically 8-10 months after substantial completion). Deficiencies identified in this post-occupancy review shall be documented and corrected under manufacturer or Contract warranties.

G. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

H. Seasonal Tests: Tests that are deferred until the system(s) will experience outdoor weather conditions closer to their design conditions. CxA will request trend data from the building automation system contractor to evaluate equipment performance.

I. Startup Reports: Documentation of inspections and procedures necessary to take a piece of equipment from a static state into an operating state (e.g. belt tension, oil levels, labels affixed, gauges in place, sensors calibrated, etc.). These forms are typically provided by the manufacturer of the piece of equipment and are completed by the contractor/vendor/manufacturer responsible for performing startup.
J. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

K. Systems Manual: Manual assembled by the CxA with assistance from the A/E and construction team. Manual will include control schematics, sequences of operation, control setpoints, alarm notifications, and other relevant documentation needed to understand the operation of the commissioned systems. This document is separate from the O&M Manuals provided by the Contractor.

1.3 SUBMITTALS

A. Equipment Submittals: Contractor shall provide CxA electronic copies of submittals for the equipment in the Cx scope. Cx submittal reviews shall be concurrent with the A/E review.
1. CxA shall have a minimum of 2 days to review general equipment submittals and provide comments to A/E.
2. CxA shall have a minimum of 5 days to review control system submittals and provide comments to A/E.
3. A/E shall incorporate and/or append CxA comments to their official response. Responsibility to approve submittals resides with the A/E.
4. CxA shall review up to one (1) resubmittal for each rejected submittal.
5. Final approved submittals shall be made available by the Contractor for the CxA to use in creating Cx documents.

B. Startup forms: Submit proposed form templates to CxA for approval.

C. BAS graphics submittal: Submit all customized graphics intended to be used for the equipment specific to this project within 4 weeks of Engineer-approved BAS submittal.
1. Each graphic shall include all applicable data fields with correct units of measure, labeling of equipment consistent with project schedules, and correct depiction of unit components and control devices – including integrated packaged equipment and associated control devices.
2. Submission of the BAS’s standard or “canned” graphics shall not be accepted by the CxA.
3. For multiple similar units/equipment, it is acceptable to submit only one graphic for each type.

D. Building Air Leakage Testing Procedures: Procedures will be submitted by the Test, Adjust and Balance (TAB) contractor for the building envelope leakage test in accordance with ASTM-E779.

E. Completed Startup Reports: Submit completed forms for review of CxA.

F. Completed Pre-Functional Checklists: Submit completed forms for review of CxA and to indicate equipment is ready for FPT witnessing.

G. TAB Report: Submit copy to CxA to indicate project equipment has been balanced and is ready for FPT witnessing.

H. Cx Test Request Form: Submit form identifying which equipment/system is ready to be field-witnessed by the CxA while undergoing its specific Functional-Performance Test. A sample form is included at the end of this Section.

I. Training Plans: Contractors required to perform training on commissioned equipment shall submit a Training Plan and/or schedule outlining the trade or discipline, company/person leading the session, topic(s) of discussion, location, and time allotted for each session.
1.4 **COMMISSIONING AUTHORITY**

A. The Commissioning Authority shall be contracted directly by the Owner. The Contractor and sub-contractors are responsible to execute the commissioning process according to this Section.

B. The Commissioning Authority shall be GMC Commissioning, Inc.

1.5 **COMMISSIONING TEAM**

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives from the Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

   1. **CxA**: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
   2. Representatives of the facility user and operation and maintenance personnel.
   3. Architect and engineering design professionals.

1.6 **RACI MATRIX**

A. The following responsibility matrix outlines the major tasks of the commissioning process and the parties responsible to carry out the tasks. The shaded cells in the following table reflect the major effort for each task/action.

The RACI model is defined as follows:

1. **Responsible** – Responsible for completion of the activity
2. **Approves** – Authority who approves document and support processes and/or system changes
3. **Contribute or Review** – Supplies expertise necessary to complete the activity and may review information provided to them
4. **Informed** – Notified of system status changes but not necessarily consulted

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1.7 **OWNER’S RESPONSIBILITIES**

A. Provide the OPR documentation to the CxA and Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities as needed.

C. Provide the BOD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for reference.

1.8 **A/E RESPONSIBILITIES**

A. Attend selected commissioning team meetings when requested.

B. Perform standard submittal review, construction observation, as-built drawing review, O&M manual review, etc. as contracted.

C. Coordinate with CxA for submittal reviews and incorporate CxA comments prior to issuing disposition.

D. Coordinate resolution of system deficiencies identified during commissioning according to the Contract Documents.

1.9 **CONTRACTOR’S RESPONSIBILITIES**

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.

3. Attend commissioning team meetings typically held each day the CxA is on-site (either prior to or immediately following the day’s tests).
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Assist CxA with development of Pre-Functional Checklists and approve final version provided by the CxA.
6. Complete Startup Reports as Work is completed and provide documentation to the CxA.
7. Complete Pre-Functional Checklists as work is completed and provide documentation to the CxA.
8. Review and accept commissioning process Functional-Performance Test procedures provided by the CxA.
10. Provide support for building envelope commissioning testing include providing materials and labor needed to seal building openings in support of air leakage testing.
11. Assist CxA with obtaining documentation such as installation and operation manuals, additional submittal information, RFIs, etc.
12. Attend In-warranty Review meeting. Address deficient items at no additional cost to Owner.

1.10 SUBCONTRACTORS’ RESPONSIBILITIES
A. Subcontractors listed in the following sections shall assign representatives with expertise and authority to act on their behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
1. Include scope to complete commissioning requirements in the Contract price.
2. Attend commissioning scheduling and coordination meetings as requested.
3. Prepare schedule for respective system commissioning related activities. Include time in the project schedule for completion of installation and startup forms and Functional-Performance Tests. Include time for resolution of deficiencies found during Functional-Performance Tests.
4. Coordinate the use of the startup forms and Pre-Functional Checklists. Turn over to CxA when completed.
5. Ensure cooperation and participation of specialty subcontractors.
6. Provide to CxA a completed Cx Test Request Form certifying that all systems, subsystems, equipment and associated controls are ready for testing, including any required TAB Work. A sample Cx Test Request Form is included at the end of this section.
7. Ensure participation of major equipment manufacturers in appropriate training and testing activities.
8. Prepare a Training Plan and submit to CxA for review.
9. Execute the Functional-Performance tests while the CxA witnesses and documents.
10. Provide technician, vendor, and/or manufacturer representative intimately familiar with the installed system(s) to perform the procedures outlined in the tests.

1.11 DIVISION 23 MECHANICAL CONTRACTOR
A. Division 23 contractor shall assign representatives with expertise and authority to act on their behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
1. Review the Functional-Performance Tests developed by the CxA to ensure that test steps are safe and do not damage equipment. Recommend test revisions to streamline or improve the test procedures.
2. Complete the “Mechanical” portion of the Pre-Functional Checklists and any other checklist items within scope of Work.
3. Execute CxA provided Functional-Performance Tests for installed equipment. Although the majority of HVAC testing is focused on controls and sequences of operation, the Division 23 subcontractor shall be available to assist with deficiencies (such as racked
dampers, valve malfunction, manufacturer (local) control issues, equipment control integration, etc.).

4. This project includes Seasonal Testing. Provide personnel at the project site to execute testing during peak heating and/or cooling season(s).

1.12 BUILDING AUTOMATION SYSTEM (BAS) CONTRACTOR

A. The BAS Contractor shall execute most of the HVAC Functional-Performance testing. BAS contractor shall assign representatives with expertise and authority to act on their behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Review the Functional-Performance Tests developed by the CxA to ensure that control system points are in place to execute the tests. Recommend test revisions to streamline or improve the test procedures.

2. Complete the “Controls” portion of the Pre-Functional Checklists and any other checklist items within scope of Work.

3. Demonstrate BAS system performance to Commissioning Provider during witnessing of the Functional-Performance Tests including all modes of system operation. CxA will expect to observe the same results as those indicated in the Contractor-completed prerequisite forms.

4. Provide controls system technician intimately familiar with the system for use during witnessing of the Functional-Performance Tests.

5. This project includes Seasonal Testing. Completion of Seasonal Testing may be achieved through the use of submitted trend data. Provide trends as outlined in the seasonal Functional-Performance Test. Trends shall be submitted to CxA within 3 business days of initial request and shall demonstrate stability of control and equipment capacity during peak heating and/or cooling season(s). Trend data may be submitted in graphical or tabular form. Duration of trend data shall span a minimum of 24 hours with minimum polling frequencies as follows:

   a. Analog input – every 60 seconds
   b. Analog output – every 60 seconds
   c. Binary input – change of state
   d. Binary output – change of state

6. Provide personnel at the project site to execute Seasonal Testing during peak heating and/or cooling season(s). Remote testing (via submitted trend data) is acceptable only if the submitted trends accurately depict a fully functional system at design capacity.

1.13 TEST, ADJUST, AND BALANCING (TAB) CONTRACTOR

A. TAB contractor shall assign representatives with expertise and authority to act on their behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Provide TAB technician intimately familiar with the project for use during verification of TAB.

2. Submit Engineer-approved TAB report to CxA in advance of TAB verification by CxA. If an approved report is not available, provide preliminary report.

3. Take measurements requested by the CxA during TAB verification with the same instruments used during original TAB Work. CxA will expect to observe the same measurements as those indicated in TAB Report (+/- testing equipment accuracies).

4. Provide calibrated handheld test equipment (for airflow, temperature, humidity, amperage, pressure, etc.) as dictated within the Functional-Performance Tests for use during on-site testing.

5. Provide power quality monitoring/meters at critical end-use devices (such as power distribution units for servers).

6. Provide, install, setup, configure and operate fan wall blower doors for positive building pressure testing procedures in accordance with ASTM E779. Provide dedicated personnel with building envelope testing experience. Testing equipment shall be capable
of trending data including, but not limited to, building pressure and air leakage rate at 5 second intervals for the duration of testing, assumed at 4 hours. Data shall be provided in electronic (excel or CSV) format to the CxA for review.

1.14 **CXA RESPONSIBILITIES**

A. Organize and lead the commissioning team.

B. Provide Cx Plan.

C. Lead commissioning team meetings.

D. Provide Project-specific Pre-Functional Checklists with input from contractors.

E. Provide Project-specific Functional-Performance Tests.

F. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 10 to 100 percent. Verification will include, but is not limited to, equipment submittals, Startup Reports, Pre-Functional Checklists, training, operating and maintenance data, Functional-Performance Tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

G. Prepare and maintain the Issues Log.

H. Witness systems, assemblies, equipment, and component startup using random sampling.

I. Write a Cx Field Report for each on-site commissioning visit.

J. Prepare a Final Cx Report at the end of the Project.

K. Prepare Systems Manual at the end of the Project.

L. Lead In-warranty Review meeting.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.1 **PRE-FUNCTIONAL CHECKLISTS (PFC)**

A. All equipment within the Cx scope of work shall have a completed PFC.

B. The Division 1 Contractor shall facilitate the use of the PFCs so that each item is checked by the responsible subcontractor.

C. Contractors shall provide assistance to CxA when requested to prepare PFC for all equipment scheduled to be commissioned. The format of the PFC is such that checklist items are separated into typical divisional scope sections. If a checklist item is outside of the subcontractor’s scope, it is the Division 1 contractor’s responsibility to coordinate the completion of the item through the subcontractor contractually responsible. Contractor shall accept final version of PFC.

D. The CxA shall provide the Division 1 Contractor and the installing subcontractors with the final approved PFC. To ensure checklist completion is kept current, the Division 1 Contractor shall provide clear plastic sleeves for each Pre-Functional Checklists and secure them to each piece
of equipment with a chain or wire. Each responsible subcontractor shall update the checklist as the items are completed.

E. The Division 1 Contractor shall submit to the CxA all completed Pre-Functional Checklists as indication that the equipment is ready to be tested and witnessed by the CxA.

### 3.2 STARTUP REPORTS

A. The Division 1 Contractor shall determine which subcontractor(s) is/are responsible for the startup process for each specific piece of equipment.

B. The responsible subcontractor shall prepare the startup form using the manufacturer’s recommended startup procedures and modifying it as necessary to meet the specific project requirements.

C. Startup forms shall have a space provided for sign-off at each individual step in the process as well as a sign-off and date at the bottom stating that all steps have been completed.

D. The Division 1 Contractor shall submit to the CxA all completed Startup Reports.

### 3.3 FUNCTIONAL-PERFORMANCE TESTING

A. CxA will create an FPT for each type of equipment within the Cx scope of work.

B. The Division 1 Contractor shall determine which subcontractor(s) is/are responsible for the Functional-Performance Test execution for each specific piece of equipment.

C. The Division 1 Contractor shall have the responsible subcontractor review and approve Functional-Performance Tests prepared by CxA to ensure they are applicable to the project, can be performed, and will not damage equipment.

D. The Functional-Performance test for a specific piece of equipment shall not be executed until a Pre-Functional Checklists and a Cx Test Request Form is received by the CxA.

E. The CxA will schedule through the Division 1 Contractor the Functional-Performance Test witnessing of selected pieces of equipment / systems.

### 3.4 NON-CONFORMANCE AND RETESTING

A. Non-Conformance.

   1. The CxA will record the results of the testing. All deficiencies, non-conformance issues, or test failures shall be noted and reported to the Contractors in the Issues Log, maintained by the CxA in a punch-list format.

   2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.

   3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures; however, the CxA will not be pressured into overlooking deficient Work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner’s Representative.

B. Re-testing.

   1. The Contractor shall retest the equipment until all deficiencies have been resolved and provide signatures where applicable on the Functional-Performance Test form indicating that the deficiency has been corrected. The CxA will witness retesting at their discretion based on the criticality of the deficiency and time available on site.

   2. The time/cost for the CxA to perform any re-testing will be back-charged to the Division 1 Contractor if either (a) an item was overlooked in the prerequisite documentation or (b) completion of an item was misrepresented in the prerequisite documentation. The
Division 1 Contractor may then choose to recover costs from the party responsible for the item.

3. Re-testing by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Division 1 Contractor. The contractors will be provided with the commissioning test forms in advance to perform the tests as part of their checkout procedures.

3.5 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any Test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of Testing may be delayed upon approval of the Owner. These tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties due to unforeseen deferred testing will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system’s design) shall be completed as part of this Contract at no additional cost. The Contractors shall coordinate this activity. Seasonal testing may be accomplished by utilizing trend data from the building automation system. Point trends will be evaluated for ability to maintain setpoint as well as stability.

3.6 TRAINING REQUIREMENTS

A. This training requirement section shall be a supplement to other specified training requirements.

B. In efforts to enhance the Owner’s knowledge of the new facility’s equipment and systems, the CxA will review the training schedule for compliance with Owner’s Project Requirements and communicated needs of the Owner’s maintenance staff. The Contractor shall submit to the CxA the proposed Training Plan to be used at the end of the project, inclusive of trade, company/person leading the session, topic of discussion, location, date(s), and time allotted for each session.

3.7 COMMISSIONING O&M DOCUMENT REQUIREMENTS

A. This O&M document requirement section shall be a supplement to other specified O&M document requirements.

B. In efforts to enhance the installing subcontractor’s and the Owner’s knowledge of the installation and operating information related to the equipment and systems, one set of O&M documents shall be delivered to the CM/GC’s on-site office 45 days after approved equipment submittals. The purpose of on-site O&M documentation is to have reference material available to the A/E, Owner, CM/GC, and installing sub-Contractors for the purposes of ensuring that the equipment and systems are installed in accordance with the manufacturer’s recommendation.

C. The CxA will be reviewing the O&M manuals with the expectation that the documents will accurately reflect the equipment installed on the project. Contractor shall incorporate comments to edit manuals project-specific.

3.8 IN-WARRANTY REVIEW

A. Contractor shall participate in an in-warranty review meeting to take place approximately 10 months into the warranty period lead by the Owner / CxA to discuss any unresolved warranty issues.

END OF SECTION 01 91 13
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Special or Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections:
   1. Section 01 40 00 - Quality Requirements
   2. Division 03 - Concrete
   3. Division 31 – Earthwork
   4. Division 32 – Exterior Improvements

1.2 DESCRIPTION

A. Geotechnical (Soils) Investigation Report and Additional Letters:
   1. A Subsurface Investigation Report has been prepared for the Work site by:
      SMS Geotechnical Solutions, Inc.
      5931 Sea Lion Place, Suite 109
      Carlsbad, California 92010
      Project No. GI-18-04-122, Dated July 17, 2018
   2. The Soils Investigation Report and any Addenda or Update Letters by the Geotechnical Engineer may be inspected at the offices of the Architect, College District or Geotechnical Engineer. These reports may also be included as an Appendix to this Project Manual. Bidders are urged to examine all geotechnical investigation data and make their own examination of the site before bidding.

B. Use of Data:
   1. This report(s) (and supplemental letters and addenda by Geotechnical Engineer) was obtained only for the Owner’s, Architect's and Engineers’ use in design and is not a part of the Contract Documents, unless specifically indicated or referenced as such in the Contract Documents. The Contractor and appropriate subcontractors shall read and be familiar with the reports before commencing earthwork.
   2. Reports are available for bidder's information, but are not a warranty of subsurface conditions.
   3. Report data on indicated subsurface conditions is not intended as representative or a warranty of accuracy or continuity between soil borings. It is expressly understood that District and Architect will not be responsible for interpretations or conclusions drawn therefrom by Bidders. The District and Architect further disclaim responsibility for interpretation of the data by bidders, as in projecting soil-bearing values, rock profiles, soil stability and the presence, level and extent of underground water. Data is made available for convenience of Bidders.
   4. The report may be used by the Contractor as a guide for all earthwork, trenching, installation of foundations, and other below-grade work. The Contractor is cautioned that while the report may be used for assistance, all responsibility for subsurface conditions and execution of the Work based on recommendations in the report shall remain with the Contractor. Recommendations in the report may be followed, but specific requirements shown on the Drawings and in each of the Contract Document Specification Sections shall take precedence over general recommendations included in the report. Bring any discrepancies to the attention of the District and Architect prior to proceeding with the Work in question.
1.3 SITE EXAMINATION

A. Bidders shall visit the site and acquaint themselves with existing conditions.

B. Without cost to the Owner, the Contractor may take additional soil borings or make other explorations to further determine the site soil or subsurface conditions. Such investigations may be performed only under time schedules and arrangements approved in advance by the District’s Construction Manager and the Architect.

C. Upon completion of additional exploratory work, restore the site as directed by District and Architect. Backfill the test holes and pits using removed material. If removed material is not sufficient, provide additional compatible material of similar character to the native soil. Compact the backfill to same density as adjacent soil.

D. The Contractor shall be fully responsible for any deductions or conclusions made on the basis of any information or data collected from the additional exploratory work.

1.4 FIELD OBSERVATION / QUALITY ASSURANCE

A. A Construction Geotechnical (Soils) Engineer will be retained by the District to observe performance of Work in connection with excavating, trenching, filling, backfilling, and grading, and to perform compaction tests.

B. Work performed that does not meet specified technical or design requirements shall be removed and replaced in accordance with project specifications or directives by the District’s Construction Manager. No deviation from the contract documents without specific and written approval from the District, Architect, Geotechnical Engineer and Division of the State Architect (DSA) will be allowed.

C. In addition to complying with these specifications and requirements of governmental agencies having jurisdiction, comply with the directives of the Owner’s Geotechnical Consulting Engineer representative at the jobsite during earthwork operations. Notify Architect and District’s Construction Manager of any discrepancies in the Specifications and actual site conditions, or of any discrepancies between Geotechnical Engineer’s directives and Contract Documents, prior to proceeding with the disputed work.

END OF SECTION
SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Form-facing material for cast-in-place concrete.
   2. Form liners.

B. Related Requirements:
   1. Section 32 13 13 "Concrete Paving" for formwork related to concrete pavement and walks.

1.3 DEFINITIONS

A. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review the following:
      a. Special inspection and testing and inspecting agency procedures for field quality control.
      b. Construction, movement, contraction, and isolation joints
      c. Forms and form-removal limitations.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:
   1. Exposed surface form-facing material.
   2. Concealed surface form-facing material.
   3. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
   1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
   2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
      a. Location of construction joints is subject to approval of the Architect.
   3. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Field quality-control reports.
C. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
   1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
   2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:
   1. Provide continuous, true, and smooth concrete surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints.
   3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 “Cast-In-Place Concrete, and as follows:
      a. Plywood, metal, or other approved panel materials.
      b. Select plywood type of form as required to achieve specified finish. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
         1) APA HDO (high-density overlay). Use this for glossy finish.
         2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed. Use this for matte finish.
         3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed. Coarse-texture finish.
         4) APA Plyform Class I, B-B or better; mill oiled and edge sealed. Coarse-texture finish.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
   1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 RELATED MATERIALS


B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   2. Form release agent for form liners shall be acceptable to form liner manufacturer.

C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 03 30 00 “Cast-In-Place Concrete” for as-cast finishes.

C. Limit concrete surface irregularities as follows:

D. Construct forms tight enough to prevent loss of concrete mortar.
   1. Minimize joints.
   2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
   1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
   2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
   1. Provide and secure units to support screed strips.
   2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
   1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
   2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
   1. Determine sizes and locations from trades providing such items.
   2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:
   1. Construct joints true to line with faces perpendicular to surface plane of concrete.
   2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   3. Place joints perpendicular to main reinforcement.
   4. Space vertical joints in walls as indicated on Drawings.
M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
   3. Clean embedded items immediate prior to concrete placement.

B. Clean and repair surfaces of forms to be reused in the Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
   1. Align and secure joints to avoid offsets.
   2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
   1. Align and secure joints to avoid offsets.
   2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections: Inspect formwork for shape, location, and dimensions of the concrete member being formed.
SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.3 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at the Project site.
1. Review the following:
   a. Special inspection and testing and inspecting agency procedures for field quality control.
   b. Construction contraction and isolation joints.
   c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of steel reinforcement.
B. Minutes of preinstallation conference.
C. LEED: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.5 QUALITY ASSURANCE
A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
   1. Store reinforcement to avoid contact with earth.
PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
   1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
      a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
   1. Finish: Galvanized.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:
   1. Do not cut or puncture vapor retarder.
   2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.
   1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
F. Splices: Lap splices as indicated on Drawings.
   1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar
diameters at splices, or 24 inches, whichever is greater.
   2. Stagger splices in accordance with ACI 318.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material in
accordance with ASTM A780.

3.3 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.4 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at
locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement.
   2. Continue reinforcement across construction joints unless otherwise indicated.
   3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate
or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting
agency to perform field tests and inspections and prepare test reports.

B. Inspections:
   1. Steel-reinforcement placement.

END OF SECTION
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

   B. Related Requirements:
      1. Section 03 10 00 "Concrete Forming and Accessories"
      2. Section 03 20 00 "Concrete Reinforcing"

1.3 DEFINITIONS
   A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

   B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site or Contractor's office.
      1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
         a. Contractor's superintendent.
         b. Independent testing agency responsible for concrete design mixtures.
         c. Ready-mix concrete manufacturer.
         d. Concrete Subcontractor.
         e. Special concrete finish Subcontractor.
      2. Review the following:
         a. Special inspection and testing and inspecting agency procedures for field quality control.
         b. Construction joints, control joints, isolation joints, and joint-filler strips.
         c. Vapor-retarder installation.
         d. Cold and hot weather concreting procedures.
         e. Concrete finishes and finishing.
         f. Curing procedures.
         g. Forms and form-removal limitations.
         h. Floor and slab flatness and levelness measurements.
         i. Concrete repair procedures.
         j. Concrete protection.

1.5 ACTION SUBMITTALS
   A. Product Data: For each of the following.
      1. Portland cement.
      2. Fly ash.
3. Admixtures:
   a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

4. Vapor retarders.
5. Floor and slab treatments.
7. Curing materials.
8. Repair materials.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For liquid floor treatments and curing and sealing compounds, documentation including printed statement of VOC content.
3. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   a. Environmental Product Declaration: For each product.
   b. Multi-Attribute Optimization declarations: for each product.
   c. Raw Material Source and Extraction Reports: for each product.
   d. Leadership Extraction Practices reports or certifications: for each product.
   e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
4. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings.

C. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
9. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
10. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
11. Intended placement method.
12. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   a. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
B. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Curing compounds.
   4. Floor and slab treatments.
   5. Bonding agents.
   6. Adhesives.
   7. Vapor retarders.

C. Material Test Reports: For the following, from a qualified testing agency:
   1. Portland cement.
   2. Fly ash.
   3. Aggregates.
   4. Admixtures:
      a. Permeability-Reducing Admixture: Include independent test reports, indicating
         compliance with specified requirements, including dosage rate used in test.

D. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria
   AC198.

E. Preconstruction Test Reports: For each mix design.

F. Field quality-control reports for testing and inspection.

G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-
   mixed concrete products and that complies with ASTM C94 requirements for production
   facilities and equipment.
   1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed
      Concrete Production Facilities."

B. Laboratory Testing Agency Qualifications: This is for Contractor-retained testing agency for
   concrete mixture design testing. Agency shall be qualified in accordance with ASTM C1077
   and ASTM E329 for testing indicated, and employing an ACI-certified Concrete Quality Control
   Technical Manager.
   1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing
      Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency
      laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction
   testing on each concrete mixture. This Contractor-employed testing agency for above work
   shall not be the same agency as the Owner-employed testing agency for concrete.
   1. Include the following information in each test report:
      a. Admixture dosage rates.
      b. Slump.
      c. Air content.
      d. Seven-day compressive strength.
      e. 28-day compressive strength.
      f. Permeability.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301.

2.2 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Source Limitations:
1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
2. Obtain aggregate from single source.
3. Obtain each type of admixture from single source from single manufacturer.

C. Cementitious Materials:
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

D. Normal-Weight Aggregates: ASTM C33/C33M> coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

G. Water: ASTM C94, potable and free of dirt and impurities.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Stego Industries, LLC; Stego Wrap 15-Mil Class A Vapor Barrier or a comparable product by one of the following:
      b. Raven Industries, Inc.
      c. Reef Industries, Inc.
      d. W.R. Meadows, Inc.

2.4 LIQUID FLOOR TREATMENTS

A. Use this product on floors not receiving any other floor covering. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ChemMasters; Chemisil Plus.
      b. CheTec Int'l; ChemTec One.
      c. Conspec by Dayton Superior; Intraseal.
      d. Curecrete Distribution Inc.; Ashford Formula.
      e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
      f. Edoco by Dayton Superior; Titan Hard.
      g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
      h. Kaufman Products, Inc.; SureHard.
      i. L&M Construction Chemicals, Inc.; Seal Hard.
      j. Meadows, W. R., Inc.; LIQUI-HARD.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dayton Superior.
      b. Euclid Chemical Company (The); an RPM company.
      c. Nox-Crete Products Group.
      d. Sika Corporation.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

1. Color:
   a. Ambient Temperature Below 50 deg F: Black.
   b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
   c. Ambient Temperature Above 85 deg F: White.


E. Water: Potable or complying with ASTM C1602/C1602M.

F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B. Product to be certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.6 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations. Use as a repair material for floor slab areas beneath floor coverings.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 RELATED MATERIALS


B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types I and II, non-load bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete, as required for repair procedure

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
   1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash or Other Pozzolans: 15 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
   1. Use water-reducing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, and concrete with a w/cm below 0.50.

2.9 CONCRETE MIXTURES
1. Minimum Compressive Strength As indicated on Drawings.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verification of Conditions:
1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMBEDDED ITEMS
A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.3 INSTALLATION OF VAPOR RETARDER
A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
   a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.4 CONCRETE PLACEMENT
A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect, Construction Manager, and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
   1. If a section cannot be placed continuously, provide construction joints as indicated.
   2. Deposit concrete to avoid segregation.
   3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
      a. Do not use vibrators to transport concrete inside forms.
      b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.5 JOINTS

A. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

B. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
C. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:
   1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
   2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
   3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.7 CONCRETE PROTECTING AND CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
   2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply in accordance with manufacturer’s written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
      c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer’s written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound.
manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.8 TOLERANCES

A. Conform to ACI 117.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
   2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
   3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
      a. For Slabs-on-Grade: Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete:
   1. Repair and patch defective areas when approved by Architect.
   2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
      a. Limit cut depth to 3/4 inch.
      b. Make edges of cuts perpendicular to concrete surface.
      c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
      d. Fill and compact with patching mortar before bonding agent has dried.
      e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
      a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete’s durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

3. After concrete has cured at least 14 days, correct high areas by grinding.

4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
   a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

6. Correct other low areas scheduled to remain exposed with repair topping.
   a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
   b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
   c. Place patching mortar before bonding agent has dried.
   d. Compact patching mortar and finish to match adjacent concrete.
   e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect’s approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect’s approval.

3.12 FIELD QUALITY CONTROL AND TESTING

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
   1. Testing agency shall immediately report to Architect, Contractor, Owner, and concrete manufacturer any failure of Work to comply with Contract Documents.
2. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
   a. Test reports shall include reporting requirements of ASTM C31/C31M and ASTM C39/C39M, including the following as applicable to each test and inspection:
      1) Project name.
      2) Name of testing agency.
      3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      4) Name of concrete manufacturer.
      5) Date and time of inspection, sampling, and field testing.
      6) Date and time of concrete placement.
      7) Location in Work of concrete represented by samples.
      8) Date and time sample was obtained.
      9) Truck and batch ticket numbers.
     10) Design compressive strength at 28 days.
     11) Concrete mixture designation, proportions, and materials.
     12) Field test results.
     13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
     14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:
   1. Verification of use of required design mixture.
   2. Concrete placement, including conveying and depositing.
   3. Curing procedures and maintenance of curing temperature.
   4. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day’s pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
      a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C143/C143M:
      a. One test at point of placement for each composite sample, but not less than one test for each day’s pour of each concrete mixture.
      b. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
      a. One test for each composite sample, but not less than one test for each day’s pour of each concrete mixture.
   4. Concrete Temperature: ASTM C1064/C1064M:
      a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C31/C31M:
      a. Cast and laboratory cure two sets of two 6-inch by 12-inch cylinder specimens for each composite sample.
a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 1 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

9. Additional Tests:
   a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
   b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
      1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.13 PROTECTION

A. Protect concrete surfaces as follows:
   1. Protect from petroleum stains.
   2. Diaper hydraulic equipment used over concrete surfaces.
   4. Prohibit use of pipe-cutting machinery over concrete surfaces.
   5. Prohibit placement of steel items on concrete surfaces.
   6. Prohibit use of acids or acidic detergents over concrete surfaces.
   7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION
SECTION 03 35 43
POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes interior polished concrete finishing, including staining, located in Lobby and Student Gathering Area as indicated.
   1. Interior Concrete for polished concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Related Requirements:
   1. Section 03 30 00 "Cast-in-Place Concrete" for concrete not designated as polished concrete.
   2. Section 32 13 16 "Decorative Concrete Paving" for Lithocrete process concrete finish.

1.3 DEFINITIONS

1.4 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Cast-in-place concrete subcontractor.
      e. Polished concrete finishing Subcontractor.
   2. Review curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.

B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

C. Samples for Initial Selection: For each type of product requiring color selection.

D. Samples for Verification: For each type of exposed color.

1.6 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer.
B. Material Certificates: For each of the following, signed by manufacturers:
   1. Repair materials.
   2. Stain materials.
   3. Liquid floor treatments.

1.7 QUALITY ASSURANCE

A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and appearance variations.
   1. Locate panels as indicated or, if not indicated, as directed by Architect.
   2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Demolish and remove field sample panels when directed. Remove and re-do sample panels that are unacceptable to the Architect and District.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURER / APPLICATOR

A. The Basis-of-Design Architectural Polished Concrete System is an engineered and integrated complete installation system requiring strict adherence to all specified installation processes, equipment, diamond abrasives, concrete preparation, joint treatment and chemicals to achieve the intended result. Any substitutions from the specified products and/or processes will void the system warranty.

   1. Subject to specified requirements, other manufacturers offering comparable products and systems may include, but are not limited to:
   2. L & M Construction Chemicals
   3. Prosoco
   4. Or equal.

C. Additive Materials: 25% glass blue and green chips (as specified in Section 32 13 16) to match approved sample.
   1. Concrete color: 18-044L-SD custom color by T.B. Penick or approved equal subcontractor.

2.2 STAIN MATERIALS

A. Architect to advise through presentation of samples whether reactive or penetrating stain will be used.

B. Reactive Stain: Acidic-based stain with wetting agents and high-grade, UV-stable metallic salts that react with calcium hydroxide in cured concrete to produce permanent, variegated, or translucent color effects.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Diamatic USA
      b. Euclid Chemical Company; an RPM company.
      c. H&C Concrete Care Products.
d. L&M Construction Chemicals, Inc.
e. QC Construction Products.
g. Specialty Concrete Products, Inc.
h. Or equal.

C. Penetrating Stain: Water-based, acrylic latex, penetrating stain with colorfast pigments.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Americrete, Inc.
   b. H&C Concrete Care Products.
   c. Increte Systems Inc.
   e. Diamatic USA.
   f. Or equal.

2.3 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ARDEX Americas.
   b. Diamatic USA
   c. Euclid Chemical Company; an RPM company.
   d. L&M Construction Chemicals, Inc.
   e. PROSOCO, Inc.
   f. Vexcon Chemicals Inc.
   g. Or equal.

2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 CUT LEVEL AND GLOSS LEVEL

A. Specified Floor Finish shall have a Cut Level of "Diamatic USA LEVEL 2 /salt & pepper". A slightly deeper cut the exposes the fine aggregates and begins to expose the coarse aggregates.

B. Specified Floor Finish shall have a Gloss Level of "Diamatic USA LEVEL A / low gloss". Level A Sheen - Low Gloss reading of 30 to 40. 400-grit diamond finish.
   1. Readings shall be taken not less than 10’ (3 m) on center in field areas and within 1’ (0.3 m) of floor area perimeters. In no case shall a reading be below 2% of specified minimum sheen.

3.2 POLISHING

A. Polish: Level A or 2: Low sheen, 400 grit Match design reference sample.

B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
   1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
4. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
5. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
6. Control and dispose of waste products produced by grinding and polishing operations.
7. Neutralize and clean polished floor surfaces.

3.3 STAINING

A. Newly placed concrete shall be at least 30 days old before staining.

B. Prepare surfaces according to manufacturer's written instructions and as follows:
   1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
   a. If reactive stains are required, do not use acidic solutions to clean surfaces.
   2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by grinding, sanding, or abrasive blasting. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
   3. Comply with the following if acid etching of concrete surfaces for penetrating stains is required. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
   4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F 710 to ensure pH is between 7 and 8.

C. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain according to ASTM D 4263 by tightly taping 18-by-18-inch, 4-mil-thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.

D. Reactive Stain: Apply reactive stain to concrete surfaces according to manufacturer's written instructions and as follows:
   1. Apply stain by uncolored bristle brush, roller, or high-volume, low-pressure sprayer and immediately scrub into concrete surface with uncolored, acid-resistant nylon-bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
   2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.

E. Penetrating Stain: Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:
   1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
   2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
   3. Rinse until water is clear. Control, collect, and legally dispose of runoff.
F. Protection: Protect polished and decorative concrete from staining, laitance, and contamination during remainder of construction period, until Substantial Completion and Owner acceptance.

END OF SECTION
SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 05 50 00 “Metal Fabrications”

1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Shrinkage-resistant grout.

1.3 DEFINITIONS

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers’ written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site or Contractor’s office.

1.6 ACTION SUBMITTALS

A. Product Data:
   2. Threaded rods.
   3. Shop primer.
   5. Galvanized repair paint.
   6. Shrinkage-resistant grout.

B. Sustainable Design (LEED) Submittals:

   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Environmental Product Declaration: For each product.
   3. Health Product Declaration: For each product.
   4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
   5. Laboratory Test Reports: Architectural Coatings: For clear wood finishes, primers, and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the South Coast Air Quality Management District Rule #1113.
   6. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings.
C. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment Drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.
   5. Identify members not to be shop primed.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
   1. Power source (constant current or constant voltage).
   2. Electrode manufacturer and trade name, for demand-critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer fabricator's testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Source quality-control reports.

1.8 QUALITY ASSURANCE

A. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 to SSPC-QP 3.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:
   1. ANSI/AISC 303.
   2. ANSI/AISC 341.
   3. ANSI/AISC 360.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 30 percent.
   1. W-Shapes: 60 percent.
   2. Channels, Angles, M, S-Shapes: 60 percent.
   3. Plate and Bar: 25 percent.
   4. Cold-Formed Hollow Structural Sections: 25 percent.
   5. Steel Pipe: 25 percent.
   6. All Other Steel Materials: 25 percent.

B. W-Shapes: ASTM A992/A992M Grade 50.

C. Channels, Angles Shapes: ASTM A36/A36M.

D. Plate and Bar: ASTM A36/A36M.

E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

G. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.

H. Steel Forgings: ASTM A668/A668M.

I. Welding Electrodes: Comply with AWS requirements.

2.3 PRIMER

A. Steel Primer:
   1. Fabricator’s standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat that may be required.
   2. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

2.4 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
   1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

D. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

B. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish (where indicated): Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.8 SHOP PRIMING

A. Shop prime steel surfaces, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
   1. SSPC-SP 2 minimum.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
   1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
   2. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E165/E165M.
      b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E164.
      d. Radiographic Inspection: ASTM E94/E94M.
   3. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

   1. Set plates for structural members on wedges, shims, or setting nuts as required.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
   2. Verify weld materials and inspect welds.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
      a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
         1) Liquid Penetrant Inspection: ASTM E165/E165M.
         2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
         3) Ultrasonic Inspection: ASTM E164.
         4) Radiographic Inspection: ASTM E94/E94M.

3.5 PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Roof deck (Used at Exterior Canopies)

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Evaluation Reports: For steel deck, from ICC-ES.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.


1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   2. ASC Profiles, Inc.
   3. Canam Steel Corporation; Canam Group, Inc.
   4. Epic Metals Corporation.
   5. Verco Decking, Inc., a Nucor company.
   6. Or approved equal.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
      b. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."
   2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33 zinc coating.
   3. Deck Profile: As indicated. 6 inch pitch. 24 inch cover width.
   4. Profile Depth: 2 inches.
   5. Design Uncoated-Steel Thickness: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work. Retain paragraph below if mechanical fastening is permitted.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing Agency to prepare test and inspection reports.

3.4 PROTECTION

D. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer’s written instructions.

E. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
   2. Wire brushing, cleaning, and repair painting of bottom (exposed and finished) deck surfaces are included in Section 09 91 13 “Exterior Painting”.

END OF SECTION
SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Steel framing and supports for countertops.
   2. Steel tube reinforcement for low partitions.
   3. Steel framing and supports for mechanical and electrical equipment.
   4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   5. Miscellaneous steel trim.
   6. Metal ladders.
   7. Metal bollards.
   8. Mesh railing and guardrail infill panel.
   10. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:
   1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
   2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:
   1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
   2. Section 05 12 00 "Structural Steel Framing"
   3. Section 05 52 13 "Pipe & Tube Railings"
   4. Painting: Division 09.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Paint products.
   2. Grout.
   3. Mesh railing infill panel (McNichols “Eco-Mesh” or approved equal).
4. Manufactured ladders

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   1. Provide Shop Drawings for the items listed in Article 1.2A above.

C. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Environmental product declaration.
   3. Environmental Product Declaration: For each product.
   4. Health Product Declaration: For each product.
   5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer preparing submittal calculations.

B. Welding certificates.

C. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

F. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.  
   1. Size of Channels: 1-5/8 by 1-5/8 inches, unless otherwise noted.
   2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.108-inch (12 gage) nominal thickness.

I. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.


M. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.


2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless-steel fasteners for fastening aluminum, stainless steel and nickel silver.
   2. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

G. Post-Installed Anchors: Torque-controlled expansion anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Division 09 Painting Sections. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer and compatible with topcoat. For use with all metal substrates except those designated to receive High Performance Coating in Section 09 91 13 or 09 91 23.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Compatible with high performance topcoat specified in Division 09.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carboline Company.
      b. PPG Paints.
      c. Tnemec.
      d. Sherwin-Williams Company.
      e. Or Equal.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL LADDERS

A. Steel Ladders: Comply with ANSI A14.3
   1. Space siderails 16 inches apart unless otherwise indicated.
   2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
   3. Rungs: 3/4-inch-diameter or square steel bars.
   4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) ALGRIP.
         2) Harsco Industrial IKG, a division of Harsco Corporation.
         3) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
         4) Or Equal.
   6. Support each ladder at top and bottom and not more than 72 inches o.c. with welded or bolted steel brackets.
   7. Shop-prime paint interior ladders, including brackets and fasteners.
B. Aluminum Ladders (Contractor's Option to Steel Ladders):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Alaco Ladder Co.
   b. O'Keeffe's Inc.
   c. Precision Ladders, LLC.
   d. Royalite Manufacturing, Inc.
   e. Or Equal.
2. Space siderails 16 inches apart unless otherwise indicated.
3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.
4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
5. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.
6. Support each ladder at top and bottom and not more than 72 inches o.c. with welded or bolted aluminum brackets.

2.8 STEEL MESH RAILING INFILL PANEL

A. Basis-of-Design: McNichols “Eco-Mesh” Modular Façade/Screen” as manufactured by McNichols Co, Tampa, FL, Tel. 800-237-3820; sales@mcnichols.com.
1. Provide two-layer 2"x 2" Type 304 stainless steel mesh railing infill panel.
4. Comply with manufacturer’s printed specifications and installation instructions.

B. Edge trim channel shall be the panel width with 1” returns, 16 gage Type 304 stainless steel sheet welded to the wire frame panels with all exterior surfaces ground smooth. Finish to match wire.

C. Commercial Grade Finish: Apply this to the HSS Posts. All trim, posts, caps plus miscellaneous clips shall be fabricated, cut, bent and drilled prior to receiving a multi-grade phosphate wash, a thermally-set epoxy primer and a thermally set powder paint finish. Color to be selected by Architect.

D. Stainless Steel Fasteners: Provide Type 304 stainless-steel fasteners for exterior use.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim where indicated.

D. Prime interior miscellaneous steel trim with zinc-rich primer where indicated.

2.10 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.
1. Cap bollards with 1/4-inch-thick steel plate.
B. Fabricate bollards with 3/8-inch-thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts. 
   1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch-thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.

E. Galvanize metal bollards and sleeves after fabrication.

2.11 PIPE GUARDS

A. Fabricate pipe guards from 3/8-inch-thick by 12-inch-wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.

B. Galvanize pipe guards after fabrication.

2.12 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

2.13 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with universal shop primer.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
3. Other Items: SSPC-SP 3, “Power Tool Cleaning.”

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.16 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.


PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for overhead doors and sectional doors securely to, and rigidly brace from, building structure.
C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
   1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

A. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer’s written instructions. Slope grout up approximately 1/8 inch toward bollard.

B. Fill bollards solidly with concrete, mounding top surface to shed water (unless bollard has a steel cap).

3.4 INSTALLING PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.5 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION
SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   1. Section 05 50 00: “Metal Fabrications” for steel mesh railing infill panels.

1.2 SUMMARY

A. Section includes steel pipe and tube railings.

1.3 COORDINATION

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Railing brackets.
   2. Grout and anchoring cement.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

D. Evaluation Reports: For post-installed anchors, from ICC-ES.

E. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

B. Building Code Requirements (CBC Section 11B-505).
   1. Top of gripping surfaces of handrails shall be 34” minimum and 38” maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.
   2. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1- ½” minimum. Handrail may be located in a recess if the recess is 3” maximum deep and 18” minimum clear above the top of the handrail.
   3. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20% of their length. Where provided, horizontal projections shall occur 1-½” minimum below the bottom of the handrail gripping surfaces.
   4. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-¼” minimum and 2” maximum.
   5. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4” minimum and 6-¼” maximum, and a cross-sectional dimension of 2-¼” maximum.
   6. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.
   7. Handrails shall not rotate within their fittings.
   8. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
   9. A 2” minimum high curb or barrier shall be provided to prevent the passage of a 4” diameter sphere rolling off the edges on a ramp or landing surface. Such a curb or barrier shall be continuous and uninterrupted along the length of a ramp. CBC Section 11B-405.9.2

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. **Handrails and Top Rails of Guards:**
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. **Infill of Guards:**
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
   b. Infill load and other loads need not be assumed to act concurrently.

B. **Thermal Movements:** Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

   1. Temperature Change: 120 deg F, ambient; 180 deg F.

2.2 **METALS, GENERAL**

A. **Metal Surfaces, General:** Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. **Brackets, Flanges, and Anchors:** Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
   1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 **STEEL AND IRON**

A. **Tubing:** ASTM A 500 (cold formed).

B. **Pipe:** ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
   1. Provide galvanized finish for exterior installations and where indicated.

C. **Plates, Shapes, and Bars:** ASTM A 36/A 36M.

D. **Cast Iron:** Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4 **FASTENERS**

A. **General:** Provide the following:
   1. **Hot-Dip Galvanized Railings:** Hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. **Fasteners for Anchoring Railings to Other Construction:** Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. **Fasteners for Interconnecting Railing Components:**
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
   2. Provide tamper-resistant square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.


2.5 MISCELLANEOUS MATERIALS

A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:
   1. By radius bends of radius indicated or as otherwise detailed.

J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:
   1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
   2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
   4. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
   1. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
   2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

A. Sleeves: Use metal sleeves preset and anchored into concrete for installing posts, where indicated on Drawings. After posts are inserted into sleeves, fill annular space between post and sleeve with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Core-Drilled Holes: Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

D. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.5 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION
SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Framing with dimension lumber.
   2. Framing with engineered wood products.
   3. Shear wall panels.
   4. Rooftop equipment bases and support curbs.
   5. Wood blocking, cants, and nailers.
   6. Wood furring and grounds.
   7. Wood sleepers.
   8. Utility shelving.

B. Related Requirements:
   1. Section 06 16 00 “Sheathing”
   2. Section 31 31 16 “Termite Control” for site application of borate treatment to wood framing.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

B. Sustainable Design Submittals:
   1. For products intending to count towards LEED Materials & Resources credits for Building product Disclosure and Optimization credit for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
      2. Environmental Product Declaration: For each product.
      3. Health Product Declaration: For each product.
      4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
      5. Product Data: For installation adhesives, indicating VOC content.
6. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

C. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated wood.
   2. Engineered wood products.
   4. Post-installed anchors.
   5. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. VOC Limits: Ultra-Low Formaldehyde: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde resins as described in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Dress lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: All lumber with a least dimension of 2 inches (nominal) shall be stamped Surface-Dry and shall have a moisture content when surfaced and when installed of not more than 19%. Lumber with a least dimension of 4 inches (nominal) or greater shall be stamped Surface-Green and air-dried to a moisture content of not more than 19% prior to its use in the structure.

D. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
   1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
   2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

C. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood floor plates that are installed over concrete slabs-on-grade.
   3. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2
   1. Species: Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions: No. 1
   1. Species: Douglas fir-larch; WCLIB or WWPA

C. Ceiling Joists: Construction or No. 2 grade.
   1. Species:
      a. Douglas fir-larch; WCLIB or WWPA.
      b. Western woods; WCLIB or WWPA.

D. Joists, Rafters, and Other Framing Not Listed Above: No. 1 grade.
   a. Species: Douglas fir-larch (north); NLGA.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   5. Furring.

B. Dimension Lumber Items: Standard, Stud, or No. 2 grade lumber of the following species:
   1. Western woods; WCLIB or WWPA.

C. Utility Shelving: Lumber with 19 percent maximum moisture content of any of the following species and grades:
   1. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 WOOD I-JOISTS

A. Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D5055. Acceptable Manufacturers: Red-Built, Trus-Joist, Louisiana Pacific or approved equal.
   1. Structural Properties: Depths and design values not less than those indicated on Drawings.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C Exposure 1, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
   1. Panels to be fire-retardant treated. Interior Type A: Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

2.7 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, as appropriate for the substrate.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.8 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
   1. Cleveland Steel Specialty Co.
   2. KC Metals Products, Inc.
   3. Simpson Strong-Tie Co., Inc.
   4. USP Structural Connectors.
B. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16 inch deep by 0.034 inch thick with hemmed edges.

D. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch thick with hemmed edges.

2.9 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

G. Do not splice structural members between supports unless otherwise indicated.
H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

J. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

L. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAIDER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal-size or 2-by-4-inch nominal-size stringers spaced 48 inches o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
   1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
   2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION
SECTION 06 16 00

SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Wood Wall sheathing.
   2. Wood Roof sheathing.
   3. Parapet sheathing.

B. Related Requirements:
   1. Section 06 10 00 "Rough Carpentry for plywood backing panels used for electrical and communications equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.

B. Sustainable Design Submittals:
   1. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
      a. Environmental Product Declaration: For each sheathing product.
      b. Multi-Attribute Optimization declarations: for each sheathing product.
      c. Raw Material Source and Extraction Reports: for each sheathing product.
      d. Leadership Extraction Practices reports or certifications: for each sheathing product.
      e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each sheathing product.
   2. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
   3. Product Data: For installation adhesives, indicating VOC content.
   4. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
PART 2 - PRODUCTS

2.1 WALL SHEATHING
   A. Plywood Sheathing: Structural I Exposure 1 sheathing.

2.2 ROOF SHEATHING
   A. Plywood Sheathing: Structural Exposure 1 sheathing.

2.3 WOOD PANEL PRODUCTS, GENERAL
   A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”
   B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated. Factory mark panels to indicate compliance with applicable standard.

2.4 FASTENERS
   A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
      1. For roof, parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153 or of Type 304 stainless steel.
      2. As a Contractor’s option to above, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.
   B. Nails, Brads, and Staples: ASTM F1667.
   C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
   D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
   E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL
   A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
   B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
   C. Securely attach to substrate by fastening as indicated on Drawings.
   D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
E. Coordinate wall, parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail edges of wall sheathing panels.
      b. Space panels 1/8 inch apart at edges and ends.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspecting Agency: Owner may engage a qualified testing agency to perform tests and inspections that they deem necessary.

END OF SECTION
SECTION 06 18 00

GLUED-LAMINATED STRUCTURAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes framing using structural glued-laminated timber.

B. Related Requirements:
   1. Section 06 10 00 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.

1.3 DEFINITIONS

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include data on lumber, adhesives, fabrication, and protection.
   2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
   3. For connectors. Include installation instructions.
   4. Laboratory Test Reports: Architectural Coatings: For clear wood finishes, primers, and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."
   5. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings.

B. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
   6. Laboratory Test Reports: For laminating adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:
   1. Show layout of structural glued-laminated timber system and full dimensions of each member.
   2. Indicate species and laminating combination.
   3. Include large-scale details of connections.
1.5 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work. Portions of glued-laminated framing will be visible in the finished building. No fabrication or construction markings shall be allowed in these locations.

2. Provide structural glued-laminated timber made from single species.

3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.

4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.


B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch that complies with combination symbols indicated.

C. Species and Grades as indicated on Drawings.

D. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

E. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

F. VOC Limits:

1. Ultra-Low Formaldehyde: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde resins as described in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
2. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

2.2 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
   1. Dress exposed surfaces as needed to remove planing and surfacing marks.

B. Camber: Provide camber as indicated in the Structural Drawings.

C. End-Cut Sealing: Immediately after end cutting each member to final length apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

2.3 FACTORY FINISHING

A. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
   1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

B. Repair by media-blasting exposed to view surfaces of all glued-laminated timbers in entire room followed by a two-coat application of Clear Finish. If media-blasting is determined to be required, a sample shall be submitted to the Architect for acceptance. If media-blasting is determined to be required, it shall be performed at no additional cost.

3.4 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 06 41 16 “Plastic-Laminate-Faced Architectural Cabinets”

C. Section 09 91 23 "Interior Painting" for priming and backpriming of opaque-painted interior finish carpentry.

1.2 SUMMARY

A. Scope of work Includes but is not limited to:
   1. Interior trim, moldings, and dimensional lumber
      a. Opaque-Painted hardwood base and trim.
      b. Solid wood casing trim. Wood door frames.

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
   1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
   2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
   3. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

B. Sustainable Design (LEED) Submittals:
   1. Laboratory Test Reports: For adhesives, sealants and primers, documentation indicating the VOC content complying with the limits, testing and product requirements of the South Coast Air Quality Management District Rule #1168.
   2. Adhesives and Sealants: Documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.21 "Adhesive Materials Application Operations."
   3. Architectural Coatings: For clear wood finishes, primers, and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."
   4. Product Data: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

C. Samples for Verification:
1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. for lumber and 8 by 10 inches for panels.
2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. for lumber and 8 by 10 inches for panels.
3. For each different type of profile lumber trim (cap, casing, and base) provide minimum 8 inch lineal section trim with factory-applied finish.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program; OR shop is a licensee of WI's (Woodwork Institute) Certified Compliance Program.

B. Installer Qualifications: Fabricator of products. A Certified participant in AWI's Quality Certification Program, or Licensee of WI's Certified Compliance Program.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" (AWS) for grades of architectural wood carpentry indicated for construction, finishes, installation, and other requirements.
   1. Provide labels and certificates from AWI or WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
   2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Adhesives: Do not use adhesives that contain urea formaldehyde.

C. VOC Limits: Use products that meet the VOC content limits of USGBC v.4 for Low-Emitting Materials, including but not limited to: sealants, primers, adhesives, sealants, and composite wood and agrifibers. Refer to paragraph 1.4B.
D. Lumber: DOC PS 20 and the following grading rules:
   4. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
   5. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."

E. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
   1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

F. Softwood Plywood: DOC PS 1.

G. Hardboard: AHA A135.4.

H. MDF: ANSI A208.2, Grade 130.

I. Particleboard: ANSI A208.1, Grade M-2.

J. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.
   1. Color: As selected by Architect from manufacturer's full range.

2.2 INTERIOR TRIM AND MOLDINGS

A. Quality Standard: Comply with Woodwork Institute (WI) AWS, Section 6.

B. Standing and Running Trim for Opaque Paint Finish
   1. Grade: Custom.
   2. Wood Species: Any closed-grain hardwood.
   3. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.
   4. Maximum Moisture Content: 10 percent.
   5. Gluing for Width: Use for lumber trim wider than 6 inches.
   6. Face Surface: Surfaced (smooth).
   7. Profile: As Indicated on Drawings.

2.3 SHELVING AND CLOTHES RODS

A. Quality Standard: Premium, Comply with WI AWS, Section 10

B. Shelf Material: 3/4-inch solid lumber
   1. At Wood-Veneer Cabinets: Solid-hardwood lumber, same species as indicated for exposed surfaces.


D. Rod Flanges: Aluminum; clear anodized.
2.4 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
   1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Multipurpose Construction Adhesive: Formulation complying with ASTM D3498 that is recommended for indicated use by adhesive manufacturer.
   1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FABRICATION

A. Back out or kerf backs of the following members except those with ends exposed in finished work:
   1. Hardwood base/trim

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum to maximum extent possible. Miter corners in shop and prepare for field assembly with bolted fittings designed to pull connections together. Disassemble components only as necessary for shipment and installation.

D. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation area.

2.6 SHOP FINISHING

A. General: Finish architectural trim at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.
   1. Backpriming: Apply two coats of sealer or primer to concealed surfaces of wood trim. Apply two coats to end-grain surfaces.

2.7 SHOP PRIMING (For Field-Applied Paint)

A. Interior Wood Trim for Opaque Finish: Shop prime with one coat of wood primer as specified in AWI Section 5, system types noted herein. Primer shall be compatible with, and from the same manufacturer as top coats specified in Section 09 91 23 “Interior Painting.”

B. Comply with referenced quality standards for any factory finishing.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
   1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
   3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
   4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
   1. Install trim after gypsum-board joint finishing operations are completed.
   2. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 SHELVING AND CLOTHES ROD INSTALLATION

A. Install rod flanges for rods as indicated. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Install rods in rod flanges.
3.6 ADJUSTING
A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.7 CLEANING
A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.8 PROTECTION
A. Protect installed products from damage from weather and other causes during construction.
B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION
SECTION 06 41 16

PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Plastic-laminate-faced architectural cabinets (custom built).
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:
1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 12 3 661 "Solid Surface and Quartz Agglomerate Countertops"

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, cabinet hardware, pulls and accessories.

B. LEED Sustainable Design Submittals: Comply with Section 01 81 13.
1. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   a. Environmental Product Declaration: For each product.
   b. Multi-Attribute Optimization declarations: for each product.
   c. Raw Material Source and Extraction Reports: for each product.
   d. Leadership Extraction Practices reports or certifications: for each product.
   e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
2. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings..
3. Laboratory Test Reports: For adhesives, sealants, primers, clear wood finishes, stains, primers, and shellacs, documentation indicating the VOC content complying with the limits, testing and product requirements established in South Coast Air Quality Management District Rule #1168.
4. Laboratory Test Reports: Architectural Coatings: For clear wood finishes, primers, and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."

5. Product Data: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other sections.
   3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
   4. Apply WI (Woodwork Institute) or AWI Certified Compliance Program label to Shop Drawings.

D. Samples for Initial Selection:
   1. Plastic laminates.
   2. PVC edge material.
   3. Thermoset decorative panels.

E. Samples for Verification:
   1. Plastic laminates, 6 by 6 inches, for each color, pattern, and surface finish and specified edge material applied to one edge.
   2. Thermoset decorative panels, 6 by 6 inches, for each color, pattern, and surface finish, with edge banding on one edge.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For the following:
   1. Composite wood and agrifiber products.
   2. Thermoset decorative panels.
   3. High-pressure decorative laminate.
   4. Adhesives.

C. Woodwork Quality Standard Compliance Certificates: Either AWI Quality Certification Program certificates or WI (Woodwork Institute) Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program; OR shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Fabricator of products. A Certified participant in AWI's Quality Certification Program, or Licensee of WI's Certified Compliance Program.

C. Mockups: Build mockup to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of one typical plastic-laminate cabinet, minimum 4 feet wide, as shown on Drawings. Cabinet mockup may be combined with Countertop mockup specified in Division 12.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
3. Remove and re-work or re-build mockups that are unacceptable to Architect.

D. All wood products designated as “FSC certified” in this specification shall be certified according to the rules of the Forest Stewardship Council (www.fscus.org)

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in “Field Conditions” Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system in the applicable portion of the building (either temporary or permanent HVAC) is operating during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction (if in-place) by field measurements, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and relay that information to cabinet fabricator/installer.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported (when fully loaded) and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the “Architectural Woodwork Standards” for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.
   1. Provide labels and certificates from AWI or WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
   2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Quality Standard: Custom Grade, Comply with WI Section 10.

C. Type of Construction: Frameless

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay
E. Laminate Cladding for Exposed Surfaces: High-Pressure Decorative Laminate, NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard:
1. Horizontal Surfaces other than Countertop: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS.

F. Materials for Semiexposed Surfaces:
1. Surfaces Other than Drawer Bodies: White thermoset decorative overlay.
2. Drawer Bodies: Solid-hardwood lumber.
4. At tops of upper cabinets: White Thermoset decorative panels.

G. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated by laminate manufacturer's designations.
2. Colors as indicated on Drawings and Interior Designer's Finish Schedule. Match approved samples.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

C. Composite Wood Products: Products shall be made without urea formaldehyde.

D. Composite Wood Products: VOC Limits: Use products that meet the VOC content limits of USGBC V4.0 EQ Credit: Low-Emitting Materials, including but not limited to: sealants, paints, primers, adhesives, sealants, and composite wood and agrifibers.
1. Ultra-Low Formaldehyde: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde resins as described in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
2. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

E. Composite Wood Products:
3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
      2) Sorm Incorporated; Primeboard Premium Wheat.

4. Softwood Plywood: DOC PS 1, medium-density overlay.
6. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 “Door Hardware.”

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Door and Drawer Pulls: Tapered bow-pull; 4-inch centers. Architect to approve sample and product data.

D. Catches:
   1. Magnetic catches, BHMA A156.9, B03141
   2. Push-in magnetic catches, BHMA A156.9, B03131

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9.
   1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; partial-extension type; zinc-plated steel or epoxy-coated steel with polymer rollers.
   2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
   3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
   4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
   5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.

H. Door Locks: BHMA A156.11, E07121. Keyed cylinder, two keys per lock, master keyed, steel with chrome finish. Locks shall be installed on all cabinet doors.

I. Drawer Locks: BHMA A156.11, E07041. Keyed cylinder, two keys per lock, master keyed, steel with chrome finish. Locks shall be installed on all drawers.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Stainless Steel: BHMA 630.
   2. Satin Nickel Plated, clear coated: BHMA 646.
L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content. Refer to specification Section 061053.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Woodworker’s option in conformance with WI standard.

2.5 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install cabinetry glass to comply with applicable requirements in Section 08 80 00 "Glazing" and in GANA’s "Glazing Manual." For glass in wood frames, secure glass with removable stops.

E. Operable parts for all accessible casework shall comply with CBC Section 11B-309.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.
B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
   1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with:
      a. No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.
      b. No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish
      c. Toggle bolts through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION
SECTION 06 64 00
PLASTIC SANITARY PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes glass-fiber reinforced plastic (FRP) interior wall paneling or wainscot, and trim accessories.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.
C. LEED Sustainable Design Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
D. VOC Content Reports for Adhesives and Sealants: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.

1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency,
   1. Flame-Spread Index: 25 or less (Class A).
   2. Smoke-Developed Index: 450 or less.
   3. Testing Agency: UL.

1.5 PROJECT CONDITIONS
A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
      a. Kemlite Company Inc.
      b. Marlite.
      c. Nudo Products, Inc.
   2. Nominal Thickness: Not less than 0.09 inch.
   4. Color: As selected by Architect from manufacturer’s complete range.
      a. Basis of Design: Marlite white S 100 S/2/S.

2.2 ACCESSORIES

A. Trim Accessories: Manufacturer’s standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
   1. Color: As selected by Architect from manufacturer’s full range. Match panel color.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer. Minimize use of exposed fasteners.

C. Adhesive: As recommended by plastic paneling manufacturer.
   1. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 “Adhesives Material Application Operations” and SCAQMD rule 1168.

D. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 - Joint Sealants. VOC content shall meet SCAQMD rule 1168.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Walls should be flat and even.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

B. Condition panels (humidity and temperature) by unpacking and placing in installation space before installation according to manufacturer’s written recommendations.

C. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide. Use full height panels and maximize piece size; Do not splice in small pieces.
   1. Mark plumb lines on substrate at for accurate installation.
   2. Locate panel joints to allow clearance at panel edges according to manufacturer’s written instructions.
3.3 INSTALLATION

A. Install plastic paneling and trim according to manufacturer’s written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive. Cover all exposed panel raw edges with trim.

D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION
SECTION 07 14 16
COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Single-component polyurethane waterproofing system; applied at earth-side of planter walls and retaining walls, and as indicated.
   2. Protection Board.

B. Related Sections:
   1. Section 07 92 00 "Joint Sealants" for joint-sealant materials and installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer’s written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, and other termination conditions.

C. Samples: For the following products:
   1. Flashing sheet, 10 by 8 inches.
   2. Membrane-reinforcing fabric, 10 by 8 inches.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
B. Source Limitations: Obtain waterproofing materials and protection course from single source from single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.
   1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer’s name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
   1. Do not apply waterproofing in rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.8 WARRANTY

A. Special Manufacturer’s Warranty: Manufacturer’s standard form in which waterproofing manufacturer and Installer agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
   1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch in width.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE BELOW-GRADE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer’s written physical requirements.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Carlisle Coatings & Waterproofing Inc.; CCW-525.
      b. CETCO; LDC 60.
2.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

B. Primer: Manufacturer's standard, factory-formulated polyurethane or epoxy primer.

C. Sheet Flashing: 50-mil- minimum, nonstaining, uncured sheet neoprene.
   1. Adhesive: Manufacturer's recommended contact adhesive.


E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.
   1. Backer Rod: Closed-cell polyethylene foam.

2.3 PROTECTION COURSE (BOARD)

A. Contractor’s Option: Select from one of the following:

B. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced one or both side(s) with plastic film, nominal thickness of 1/4 inch, with compressive strength not less than 8 psi per ASTM D 1621 and maximum water absorption by volume of 0.6 percent per ASTM C 272.

C. Protection Course: Fan folded, with a core of molded-polystyrene board insulation faced both sides with plastic film, nominal thickness of 1/4 inch, with compressive strength not less than 12 psi per ASTM D 1621 and water absorption by volume of less than 1 percent per ASTM C 272.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
   1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
   1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

D. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 1471 and manufacturer's written instructions.

B. Prime substrate unless otherwise instructed by waterproofing manufacturer.

C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
   1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
   2. Apply bond breaker between sealant and preparation strip.
   3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions.
   1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.
3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to ASTM C 1471 and manufacturer's written instructions.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate, only if recommended by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
   1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.
   2. Apply waterproofing to prepared wall terminations and vertical surfaces.
   3. Verify wet film thickness of waterproofing every 100 sq. ft..

E. Install protection course with butted joints over nominally cured membrane before starting subsequent construction operations. Cover all waterproofing with protection course so no soil is directly against waterproofing.
   1. For horizontal applications, install protection course loose laid over fully cured membrane.
   2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive. Protection board shall not be showing after planters are filled with topsoil to final elevation; Maintain board 1 inch below soil surface.

3.6 CURING, PROTECTION, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
   1. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION
SECTION 07 21 00
THERMAL AND ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Perimeter wall and ceiling insulation; interior insulation below roof deck.
   2. Concealed building insulation.
   3. Sound attenuation insulation.

B. Related Sections include the following:
   1. Section 07 54 19 “PVC Single-Ply Roofing” for insulation specified as part of roofing construction.
   2. Division 23 for Mechanical Pipe and Duct Insulation

1.2 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.3 PERFORMANCE REQUIREMENTS

A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
   1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm air velocity.
   2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Research/Evaluation Reports: For foam-plastic insulation.

C. Laboratory Test Reports: Adhesives and Sealants: Documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.21 "Adhesive Materials Application Operations."

D. Sustainable Design Submittals:
   1. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
      a. Environmental Product Declaration: For each product.
      b. Multi-Attribute Optimization declarations: for each product.
c. Raw Material Source and Extraction Reports: for each product.

d. Leadership Extraction Practices reports or certifications: for each product.

e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

2. VOC Content Reports for Adhesives and Sealants: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.

3. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.


1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer’s written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 GLASS-FIBER BLANKET INSULATION

A. Available Manufacturers:

1. CertainTeed Corporation.
2. Johns Manville.
4. Owens Corning.

B. Sound Batts: Unfaced, Glass-Fiber Blanket Insulation; ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics. Provide at interior partitions where indicated for acoustical insulation. Provide at all interior wood stud walls, and where otherwise indicated.
C. Faced, Glass-Fiber Blanket Insulation for Exterior Walls: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim-kraft, foil scrim, or foil scrim-polyethylene vapor-retarder membrane on 1 face.
   1. Manufacturers:
      a. USG Interiors, Inc./Thermafiber FS25 Insulation.
      c. Owens-Corning Fiberglas Corp./Fiberglas FS-25 Insulation.

D. R-Values: As indicated on Drawings. Minimum Value of R-19 for exterior wall batt insulation.

E. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 AUXILIARY INSULATING MATERIALS

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings. Tape shall be compatible with facer.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 "Adhesives Material Application Operations."

C. Provide other accessory materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect. Provide metal clips, impaling pins and washers, hardware, zinc-coated wires, furring channels, adhesives, fire-resistive foil tape and other items for anchoring insulation to substrates as required and recommended by insulation manufacturer.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
   1. Available Products:
      a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
      b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
      c. Gemco; Spindle Type.
   2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
   1. Available Products:
      a. Gemco; 90-Degree Insulation Hangers.
   2. Angle: Formed from 0.030-inch- thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
   3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
   1. Available Products:
      a. AGM Industries, Inc.; RC150.
      b. AGM Industries, Inc.; SC150.
      c. Gemco; Dome-Cap.
      d. Gemco; R-150.
      e. Gemco; S-150.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
   1. Available Products:
      a. AGM Industries, Inc.; TACTOO Adhesive.
      b. Eckel Industries of Canada; Stic-Klip Type S Adhesive.
      c. Gemco; Tuff Bond Hanger Adhesive.

2.5 LOOSE-FILL INSULATION

   1. ASTM E136: Rated non-combustible
   2. ASTM C 665: Non-corrosive.
   3. ASTM C 1104: Absorbs less than 1% by volume.
   4. Minimum 70% recycled content.

B. Basis-of-Design: Owens-Corning Thermafiber "Insul-Fill" Blown-in Insulation, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, or moisture.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Set vapor-retarder-faced units with vapor retarder to interior side, unless otherwise indicated.
   1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

C. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug friction-fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
   4. For wood-framed construction, install blankets according to ASTM C1320.
   5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
      a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

D. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown or as directed by Architect. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.5 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION
SECTION 07 25 00

VAPOUR-PERMEABLE SHEET WEATHER BARRIER

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a vapor-permeable air and water-resistant barrier and accessories for exterior enclosures, beneath metal plate wall panels as detailed.

B. Related Work: Coordinate with the following items which are specified in other sections:
1. Section 06 16 00 - SHEATHING for wood sheathing behind weather-resistant barrier.
2. Section 07 42 13 - ALUMINUM METAL PLATE WALL PANELS
3. Section 07 62 00 - SHEET METAL FLASHING AND TRIM for flashings, and other sheet metal work.
4. Section 09 24 00 – CEMENT PLASTERING, for Building Paper (Weather-Resistant Barrier) Types for Plaster only.
5. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, including installation instructions, detail drawings, test reports on physical and performance properties, and building code compliance reports.

B. Verification Samples: Submit clearly labeled samples of each material specified.

C. Warranty at Closeout: Submit manufacturer’s executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.

D. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

E. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints, Coatings, Adhesives and Sealants.
   1. Laboratory Test Reports: Adhesives and Sealants: Submit documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.21 "Adhesive Materials Application Operations.”

1.3 QUALITY ASSURANCE

A. Manufacturer: Minimum of 3 years experience manufacturing similar products.
B. Installer: Minimum of 2 years experience installing similar products and acceptable to the manufacturer.

C. Mock-Up: As required in Section 07 42 13, provide materials and labor for exterior wall mock-up. Include sheathing, metal panels and sheet weather barrier.

D. Pre-Installation Meeting: Conduct a pre-installation meeting a minimum of two weeks prior to commencing the Work of this Section.
   1. Agenda shall include review of requirements and submittals for water resistive barrier, including surface preparation requirements specified under other sections, status of substrate work and preparation, compatibility of materials, special details and flashings, installation procedures, testing and inspection procedures, protection, and repairs.
   2. Attendance by related trades is required.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations.

1.5 WARRANTY

A. Manufacturer's Warranty: Submit manufacturer's standard limited warranty for defects in materials.

PART 2 - PRODUCTS

2.1 SHEET WEATHER BARRIER


B. Subject to compliance with specified requirements, manufacturers producing comparable products may include, but are not limited to, the following:
   1. Carlisle Coatings & Waterproofing Inc.
   2. GCP Applied Technologies Inc.
   3. Henry Company
   4. VaproShield

C. Water-Resistive Barrier: Provide vapor-permeable air and water-resistive barrier with the following characteristics:
   1. Material: 3-layer, high-strength spun-bonded polypropylene membrane.
   2. Color: Gray.
   5. Air Permeance: Pass (< 0.2 L/(s•m²) @ 75 Pa) ASTM E2178.
   8. Tear Resistance: MD 1078 g CD 1588 g ASTM D4533.
   10. Water Penetration Resistance: 643 cm CAN/CGSB-4.2 #26.3-95
   11. Flame Spread: 25 NFPA Class A; UBC Class 1 ASTM E84.
   12. Smoke Developed: 145 NFPA Class A; IBC Class A ASTM E84.
   14. Temperature Range: -40°F to 176°F (-40°C to +80°C).
15. Maximum UV (Sunlight) Exposure: Always cover as soon as possible. Maximum exposure 6 weeks.
17. Provide “Plus” type with self-adhesive edge.

D. Accessory Products: Dorken Systems or approved equal. Accessory products shall be made and approved by weather barrier manufacturer.

1. Adhesive Tape at Overlaps: DELTA®-MULTI-BAND.
2. Elastic Rubber Compound Sealant and Adhesive: DELTA®-THAN.
3. Preformed Corners: DELTA®-FAS-CORNER.
4. Flashing: DELTA®-FLASHING.
5. Butyl Rubber Tape at Penetrations: DELTA®-FLEXX BAND.
6. Fasteners: Manufacturer’s recommended corrosion-resistant screws with plastic caps or metal gasketed washers.
7. Air and Vapor Sheet Over Substrate When Required: DELTA®-REFLEX.
8. Through-wall Flashing: DELTA®-TW FLASHING.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Clean substrate of dirt and bond breaking substances prior to beginning installation.

3.2 INSTALLATION

A. Install products in strict accordance with manufacturer’s instructions, approved submittals and the following:

1. Install water-resistive barrier prior to installation of windows and doors.
2. Overlap sheets to shed water, minimum 12 inches at exterior corners, 6 inches at vertical and horizontal seams.
3. Seal seams of water resistive barrier with approved seam tape at all vertical and horizontal overlapping seams.
4. Seal cuts and tears as recommended by manufacturer.

3.3 PROTECTION

A. Protect installed water-resistive barrier from damage during application and remainder of construction period, according to manufacturer’s written instructions.

B. Coordinate with installation of materials which cover the water-resistive barrier, to ensure exposure period does not exceed that recommended by the manufacturer.

END OF SECTION
SECTION 07 42 13
ALUMINUM METAL PLATE WALL PANELS

PART 1- GENERAL

1.01 SECTION INCLUDES

A. Aluminum metal plate wall panels, tapered and non-tapered.

1.02 RELATED REQUIREMENTS

A. Section 06 16 00 – Sheathing: Plywood substrate wall sheathing.
B. Section 07 25 00 – Weather Barriers: Air and moisture barrier required as part of metal wall panel assembly.
C. Section 07 62 00 – Sheet Metal Flashing and Trim: Field formed flashings and other sheet metal work.
D. Section 07 92 00 – Joint Sealants: Perimeter sealant.
E. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 DEFINITION

A. Metal Plate Wall Panel Assembly: Metal plate wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weather tight wall system based on AAMA CW-RS-1.

1.04 REFERENCE STANDARDS

A. AAMA - American Architectural Manufacturers Association (www.aamanet.org)
   1. AAMA CW-RS-1 – The Rain Screen Principle and Pressure Equalized Wall Design; 2012
   3. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2009
   5. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014

B. ASTM International (American Society for Testing and Materials; www.astm.org)

C. LEED – Leadership in Energy and Environmental Design
D. NAAMM – National Association of Architectural Metal Manufacturers
E. SMACNA – Sheet Metal and Air Conditioning Contractor’s National Association
F. PS - Voluntary Product Standard; National Institute of Standards and Technology (NIST)
   1. PS-1 – Structural Plywood; 2009

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate panel assemblies with rain drainage, flashing, trim, stud back-up, roofing and other adjoining work.

B. Preinstallation Meeting:
   1. Attendees:
      a. Owner.
      b. Architect.
      c. Installer.
      d. Panel manufacturer's representative.
      e. Structural support installer,
      f. Installers whose work interfaces with or affects wall panels including installers of doors, windows, and louvers.
   2. Review and finalize construction schedule.
   3. Verify availability of materials, installer's personnel, equipment, and facilities needed to maintain schedule.
   4. Review means and methods related to installation, including manufacturer's written instructions.
   5. Examine support conditions for compliance with requirements, including alignment and attachment to structural members.
   6. Review flashings, special details, wall penetrations, openings, and condition of other construction that affects this Work.
   7. Review temporary protection requirements for during and after installation of this Work.

1.06 SUBMITTALS

A. Product Data: Submit for each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal plate wall panel and accessory.

B. Shop Drawings: Submit fabrication and installation layouts of metal plate wall panels; including details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   1. Provide distinction between factory-assembled, shop-assembled, and field-assembled work.
   2. Provide details of following items at full scale.
      a. Manufacturer’s standard sheet metal trims.
      b. Components of wall panel construction, anchorage methods, and hardware.

C. Coordination Drawings: Submit exterior elevations, drawn to scale, that have the following items shown and coordinated with each other, using input from installers of the following items:
   1. Metal plate wall panels and attachments.
2. Girts or sub-framing.
3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
4. Penetrations of wall by pipes and utilities.

D. Samples: Submit for each type of exposed finish required, and prepared on samples of size as follows:
   1. Aluminum Metal Plate Wall Panels: At least 4 inch square.

E. Test and Inspection Reports: Submit test and inspection reports on each type of wall panel system provided for project based on evaluation of comprehensive tests performed by qualified testing agency.

F. Maintenance Data: Submit maintenance data for metal plate wall panels.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

H. Sustainable Design Submittals [LEED Reports]: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each wall panel product.
   2. Multi-Attribute Optimization declarations: for each wall panel product.
   3. Raw Material Source and Extraction Reports: for each wall panel product.
   4. Leadership Extraction Practices reports or certifications: for each wall panel product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each wall panel product.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least five years of documented experience.

B. Installer: Company specializing in performing work of this section and approved by manufacturer.
   1. Install system in strict compliance with manufacturer’s installation instructions.

C. Source Limitations: Obtain each type of metal plate wall panel from single source and single manufacturer.

1.08 MOCKUPS

A. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and to establish quality standards for fabrication and installation.
   1. Build mockup of typical wall panel assembly as shown on Drawings, including corner, soffits, supports, attachments, and accessories. Minimum size: 5 feet square.
      a. Include at least four panels to represent a four-way panel joint and showing full thickness.
   2. Water Spray Test: Conduct water-spray test of mockup metal panel assembly, test water penetration in accordance with AAMA 501.2.
   3. Approval of mockups does not constitute approval of deviation from Contract Documents within mockups unless these deviations are approved by Architect in writing.
   4. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed upon Date of Substantial Completion. Remove and re-do unapproved mockups.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling: Store materials in clean, dry, interior area in accordance with manufacturer’s instructions.
C. Deliver panels, components, and other manufactured items without damage or deformation.

D. Protect panels during transportation, handling, and installation from weather, excessive temperatures and construction operations.

E. Handle panels in strict compliance with manufacturer's instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface damage.
   1. Store panels vertically with top of panel down, storage of panels horizontally is not permitted.

F. Store panels covered with suitable weather tight and ventilated covering.

G. Provide storage of panels to ensure dryness, with positive slope for drainage of moisture.

H. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

I. Remove strippable protective covering from aluminum panel prior to installation.

1.10 SITE CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit assembly of this Work to be performed according to manufacturer's installation instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before panel fabrication and indicate measurements on Shop Drawings.
   1. Coordinate with construction schedule.

1.11 WARRANTY

A. See Section 01 77 00 - Closeout Submittals, for additional warranty requirements.

B. Wall System Warranty: Provide wall panel manufacturer warranty, agreeing to correct defects in manufacturing of materials within a one year period after Date of Substantial Completion.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking, or puncturing.
      b. Deterioration: Beyond normal weathering of wall system metals and other materials.

C. Panel Material Warranty: Provide panel material manufacturer warranty, agreeing to repair finish of metal plate wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 20 years from Date of Substantial Completion.
   2. Warranty Coverage: In accordance with AAMA 2605 for 70 percent PVDF resin on aluminum finish requirements.
      a. Fading, Loss of Color Retention: Loss of 5 Delta E units (Hunter) or less, in accordance with ASTM D2244.
      b. Chalking, Chalky White Powder on Panel Surface: Chalking at No. 8 or less for colors, or No. 6 for white, in accordance with ASTM D4214.
      c. Loss of Adhesion: Loss of 10 percent due to cracking, checking or peeling, or failure to adhere to bare metal.
      d. Gloss Retention: 50 percent or less in accordance with ASTM D523.
      e. Salt Spray, Accelerated: At least 4,000 hours in accordance with ASTM B117.
      f. Humidity Testing, Accelerated: At least 4,000 hours in accordance with ASTM D2247.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Dri-Design – Aluminum Wall Panel System, flat or tapered as indicated.
   1. Address: 12480 Superior Ct., Holland, Michigan 49424.
   2. Phone: (616) 355-2970; Fax: (616) 355-2972; Website: www.dri-design.com.
B. Subject to compliance with specified requirements, manufacturers producing comparable products may include, but are not limited to, the following:
1. Architectural Specialty Products, Inc.
2. Fabral
3. Firestone Metal Products, LLC
4. Metal Sales & Service, Inc.
5. Or approved equal.

2.02 PERFORMANCE REQUIREMENTS

A. Metal Plate Wall Panel Assemblies: Comply with performance requirements without failure due to defective manufacturing, fabrication, installation, or other construction defects.

B. Design, fabricate, and erect a dry joint, pressure equalized rainscreen aluminum wall panel system without use of sealants, gaskets, or butyl tape, tested as installed in compliance with AAMA 508, and as follows:
1. Cyclic Static Air Pressure Differential: Pass cycled pressure loading at 25 psf in 100 three-second cycles in accordance with ASTM E1233/E1233M.
2. Air Infiltration: Pass when tested at 1.57 psf (25 mph) in accordance with ASTM E283.
3. Water Penetration:
   a. Static: Pass water penetration test under 25.0 psf positive static air pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with ASTM E331.
   b. Dynamic: Pass water penetration test under 15.0 psf dynamic pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with AAMA 501.1.
4. Structural: Provide systems tested in accordance with ASTM E330/E330M and certified to be without permanent deformation or failure of structural members.

2.03 MATERIALS

A. Aluminum Plate: Alloy and temper as recommended by manufacturer for application and in compliance with manufacturers design requirements.
   2. Thickness: 0.080 inch.
   3. Weight: Less than 2 lbs per sf.

B. Panel Depth: 1-1/4 inch, nominal.

C. Panel Size: As indicated on Drawings.

D. Panel Joints: As indicated on Drawings.

2.04 FABRICATION

A. Fabricate and finish wall panels within manufacturer’s facilities and fulfill indicated performance requirements demonstrated by laboratory testing.
   1. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide post-finishing of panels, paint aluminum wall panels only after completion of panel fabrication and ensure exposed edges are coated.

C. Tapered Series System: Panel faces may be extended and angled in varying angles and depths providing various patterns throughout the wall panels, as indicated and as approved on shop drawings.

2.05 FINISHES
A. Comply with NAAMM's - Metal Finishes Manual for Architectural and Metal Products, for recommendations of designating finishes. Match approved sample.

B. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride (PVDF) resin system.
   1. Two-Coat Mica Fluoropolymer: AAMA 2605, fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ installation instructions.

C. Field Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 ACCESSORIES

A. Metal Plate Wall Panel Accessories: Provide components required for a complete metal plate wall panel assembly including trim, copings, fascia, mullions, sills, corner units, flashings, and similar items. Match material and finish of panels unless otherwise indicated.

B. Provide integral drainage system and manufactures standard extrusions at termination of dissimilar materials.

C. Flashing and Trim: Match material, finish, and color of adjacent wall panels.
   1. Thickness: At least 0.040 inch.
   2. Refer to Section 07 6200.

D. Panel Fasteners: Designed to withstand design loads, with at least 7/16 inch diameter head and neoprene washer.
   1. Aluminum Wall Panel Material: Provide stainless steel fasteners, or coated fastener approved by panel manufacturer or project wall consultant.

E. Sub-Girts: Hot-dip Galvanized, provide size and gage in accordance with project requirements.
   1. Furring Channel: Provide Hat, C, U or Z type as recommended by manufacturer.
   2. Flat Strap: At least 14 gage, 0.0747 inch (1.90 mm) thick.

F. Substrate Wall Sheathing: Specified in Section 06 16 00.

G. Weather Barriers: Provide climate specific weather barrier with performance characteristics for air penetration, water vapor transmission, and water penetration resistance.
   1. Refer to Section 07 25 00 for requirements.

H. Sealants: As recommended by metal panel manufacturer for openings within wall panels and perimeter conditions.
   1. Refer to Section 07 92 00 for requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, Work areas and conditions with Installer present for compliance with requirements for installation tolerances, wall panel supports, and other conditions affecting performance of this Work.

B. Examine wall framing to verify that girts, angles, channels, studs, and other structural wall panel support members and anchorage have been installed within alignment tolerances required by wall panel manufacturer.

C. Verify that weather barrier has been installed over sheathing or substrate to prevent air infiltration or water penetration.

D. Examine rough-in for components and systems penetrating wall panels to coordinate actual penetration locations relative to wall panel joint locations prior to installation.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Framing: Install sub girt, blocking, base angles, sills, furring, and other wall panel support members and provide anchorage in accordance with panel manufacturer's installation instructions.

3.03 INSTALLATION

A. Install wall panels in accordance with manufacturer's installation instructions and reviewed submittals, including pressure equalized rainscreen installation method and installation guidelines.
1. Wall panels consist of single sheets of metal formed with interlocking gutter and drainage system integral to the panel with single horizontal attachment for dry-joint rainscreen assembly.
2. Use of secondary drainage channels, brackets, support pins, joint sealants or gaskets to manage the drainage of wall panel system is not permitted.
3. Attach wall panels using progressive interlocking method, engaging bottom of panel in top of previous panel working bottom up, and left to right.
4. Install wall panels with single top attachment in pre-punched holes to allow individual panels to move due to thermal expansion.
5. Do not compromise internal gutter.

B. Install wall panels for orientation, sizes, and locations as indicated on Drawings.

C. Install wall panels with proper anchorage and other components for this Work securely in place.

D. Install wall panels with provisions for thermal and structural movement.

E. Install shims to plumb substrates as necessary for installation of wall panels.

F. Install weather tight seals at perimeter of wall panel openings.
1. Test for proper adhesion on small unexposed area of solid surfacing prior to use.
2. Refer to Section 07 9200.

1. Provide concealed fasteners where possible, and set units true to line and level as indicated.
2. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
3. Install flashing and trim as wall panel Work proceeds.

H. Install weather tight escutcheons for pipe and conduit penetrating exterior walls.

I. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by wall panel manufacturer.

J. Install attachment system to support wall panels and with provisions to provide a complete weather tight wall system, including sub girts, extrusions, flashings and trim.
1. Include attachment to supports and trims at locations using dissimilar materials.
2. Do not apply sealants to joints, unless noted otherwise on Drawings or Shop Drawings.
3. Install starter extrusion at base course and at cut panel locations.

K. Install accessories with positive anchorage to building and weather tight mounting and provisions for thermal expansion, and coordinate installation with flashings and other components.
1. Install components required for a complete wall panel assembly including trim, copings, flashings and other accessory items.

L. Weather Barrier: Install weather barrier behind wall panels and over substrate in accordance with requirements of Section 07 25 00.
3.04 TOLERANCES
   A. Shim and align wall panel units with installed tolerances of 1/4 inch in 20 feet, non-cumulative, on level, plumb, and location lines as indicated.

3.05 FIELD QUALITY CONTROL
   A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
   B. Water-Spray Test: After installation and in coordination with Mockup requirements, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.
   C. Manufacturer's Field Service: Engage a factory-authorized service representative to review, test and inspect completed metal wall panel installation, including accessories.
   D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
   E. Perform additional tests and inspections, at Contractor's expense, to verify compliance of replaced wall panels or necessary additional work with specified requirements.
   F. Prepare test and inspection reports.

3.06 CLEANING
   A. Upon completion of wall panel installation, clean finished surfaces as recommended by panel manufacturer.
   B. Upon completion of wall panel installation, clear weep holes and drainage channels of obstructions and dirt.

3.07 PROTECTION
   A. Protect installed products from damage during subsequent construction.
   B. Replace wall panels damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
SECTION 07 54 19

POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Adhered polyvinyl chloride (PVC) roofing system.
   2. Roof insulation.
   3. Cover board.
   4. Walkways.

B. Related Requirements:
   1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
   2. Section 06 16 00 "Sheathing" for wood-based, structural-use roof deck panels.
   3. Section 07 21 00 "Thermal Insulation" for insulation beneath the roof deck.
   4. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
   5. Section 07 72 00 "Roof Accessories" for roof hatch.
   6. Section 07 92 00 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
   7. Division 22 for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For insulation and roof system component fasteners, include copy of FM Approvals’ RoofNav listing.

B. Sustainable Design Submittals:
   1. Product Test Reports: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirements.
   2. Product Data: For adhesives and sealants, indicating VOC content.
   3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
   4. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   5. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
      a. Environmental Product Declaration: For each product.
      b. Multi-Attribute Optimization declarations: for each product.
      c. Raw Material Source and Extraction Reports: for each product.
      d. Leadership Extraction Practices reports or certifications: for each product.
      e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
   1. Layout and thickness of tapered insulation. Show all slopes.
   2. Base flashings and membrane terminations.
   3. Flashing details at penetrations.
   4. Tapered insulation thickness and slopes.
   5. Roof plan showing orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
   6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

D. Samples for Verification: For the following products:
   1. Roof membrane and flashing, of color required.
   2. Walkway pads or rolls, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:
      a. Submit evidence of compliance with performance requirements.
   2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.
E. Field quality-control reports from Owner’s Roof Inspector and Manufacturer’s Inspector.
F. Sample Warranties: For manufacturer’s special warranties.

1.7 CLOSEOUT SUBMITTALS
A. Maintenance Data: For roofing system to include in maintenance manuals.
B. Thermographic test reports for moisture detection showing no moisture detected within the roof assembly. Report must indicate date of start and end of flood test, and date of infrared thermographic test, testing agency's and tester's qualifications.

1.8 QUALITY ASSURANCE
A. Manufacturer Qualifications: A qualified manufacturer that is UL listed or listed in FM Approvals’ RoofNav for roofing system identical to that used for this Project.
B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS
A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY
A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system. Provide Manufacturer's No-Dollar Limit (NDL) warranty.
   2. Warranty Period: 30 years from date of Substantial Completion.
B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, and walkway products, for the following warranty period:
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
   1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
   2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the wind uplift pressures indicated on Structural Drawings or Calculations, when tested according to FM Approvals 4474, UL 580, or UL 1897.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class I or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
   1. Fire/Windstorm Classification: Class 1A-75.

E. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 or initial SRI not less than 82 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.

F. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

G. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

H. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING

A. PVC Sheet: ASTM D4434/D4434M, Type II, Grade 1, glass-fiber reinforced.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Sika Sarnafil; Sarnafil G410. or a comparable product by one of the following:
      a. Fiber-Tite
      b. Johns-Manville
      c. Duro-Last
      d. Carlisle
      e. Or approved equal.
   2. Thickness: 80 mils minimum (ASTM +/- tolerances are not acceptable).

B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants shall comply with the following limits for VOC content:
   a. Plastic Foam Adhesives: 50 g/L.
   b. Gypsum Board and Panel Adhesives: 50 g/L.
   c. Multipurpose Construction Adhesives: 70 g/L.
   d. Fiberglass Adhesives: 80 g/L.
   e. Contact Adhesives: 80 g/L.
   f. PVC Welding Compounds: 510 g/L.
   g. Other Adhesives: 250 g/L.
   h. Single-Ply Roof Membrane Sealants: 450 g/L.
   i. Nonmembrane Roof Sealants: 300 g/L.
   j. Sealant Primers for Nonporous Substrates: 250 g/L.
   k. Sealant Primers for Porous Substrates: 775 g/L.
3. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Roof Vents: As recommended by roof membrane manufacturer.
   1. Size: Not less than 4-inch diameter.

E. Bonding Adhesive: Manufacturer's standard.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
   1. Fasteners: 1-1/2-inch stainless steel fasteners with neoprene washers.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer, and approved for use in FM Approvals' RoofNav listed roof assemblies.
B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 (for all roof types) OR Type II, Class 2, Grade 2 (for single-ply membranes using water-based bonding adhesives), felt or glass-fiber mat facer on both major surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
   b. Hunter Panels.
   c. Johns Manville; a Berkshire Hathaway company.
   d. Rmax, Inc.
2. Compressive Strength: 20 psi.
4. Thicknesses:
   b. Upper Layer: As required to suit tapering and overall R-value requirements.

C. Composite Polyisocyanurate Board Insulation (Contractor’s Option to above; has factory-applied glass-fiber mat facer instead of a separate facer layer: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.
1. Facer: Type VII, glass-mat-faced gypsum board facer, 1/4 inch thick.
2. Size: 48 by 48 inches.

D. Tapered Insulation: Provide factory-tapered insulation boards to achieve indicated slope.
1. Material: Match roof insulation.
3. Slope:
   a. Roof Field: As indicated on Drawings.
   b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer’s recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive; or
2. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
3. Adhesives and sealants shall comply with the following limits for VOC content:
   a. Plastic Foam Adhesives: 50 g/L.
   b. Gypsum Board and Panel Adhesives: 50 g/L.
   c. Multipurpose Construction Adhesives: 70 g/L.
   d. Fiberglass Adhesives: 80 g/L.
   e. Contact Adhesives: 80 g/L.
   f. PVC Welding Compounds: 510 g/L.
   g. Other Adhesives: 250 g/L.
   h. Single-Ply Roof Membrane Sealants: 450 g/L.
   i. Nonmembrane Roof Sealants: 300 g/L.
   j. Sealant Primers for Nonporous Substrates: 250 g/L.
   k. Sealant Primers for Porous Substrates: 775 g/L.
4. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation
of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. Georgia-Pacific Gypsum LLC; Dens Deck Prime. (basis-of-design).
   2. Horizontal Thickness: 1/4 inch or 1/2 inch at plane of roof, as indicated on drawings.
   3. Vertical Thickness: 1/4 inch if applied over plywood sheathing. Use 1/2 inch if applied direct over metal or wood studs.

2.6 WALKWAYS

A. A rolled-out, open grid, loose-laid walkway mat used to protect the roof membrane from regular foot traffic. Made from 9/16 inch flexible PVC, in gray color.
   2. Engineered to resist winds up to 60 mpg.
   3. Shrinkage: 2% or less.
   4. Slip Resistance: ASTM F1677: 0.6/0.5.
   5. Installed per manufacturers recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.
   1. Tightly butt substrate boards together.
   2. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   3. Attach board with adhesive or mechanical fasteners per manufacturer’s requirements for specified system.

3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer’s written instructions for installing roof insulation.

C. Installation Over Wood Panel Decking:
   1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows (for 48 inch square boards).
      a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
      b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
      c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
      d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
         1) Trim insulation so that water flow is unrestricted.
         e. Fill gaps exceeding 1/4 inch with insulation.
         f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
         g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood panel decks.
            1) Fasten insulation according to requirements in FM Approvals’ RoofNav for specified Windstorm Resistance Classification.
            2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
   2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
      a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
      b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
      c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
      d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
      e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
         1) Trim insulation so that water flow is unrestricted.
         f. Fill gaps exceeding 1/4 inch with insulation.
         g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
         h. Adhere each layer of upper insulation to substrate using adhesive according to FM Approvals’ RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
            1) Set each layer of insulation and crickets in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
D. Installation of Insulation Board to Exterior Metal Canopies:
   1. Do not use mechanical fasteners that penetrate metal deck and are exposed-to-view on underside. Attach board with adhesive.
   2. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
      a. Locate end joints over crests of decking.
      b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks. Trim insulation so that water flow is unrestricted.
      c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
      d. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
      e. Fill gaps exceeding 1/4 inch with insulation.
      f. Adhere each layer of insulation to substrate using adhesive according to FM Approvals’ RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
         a. Set insulation on metal deck canopies in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
         g. Board size (adhesive-applied to metal deck): Maximum 4 feet square.
      h. All work surfaces shall be clean, dry, and free of dirt, dust, debris, oils, and other contaminants that may result in a surface that is not sound or is uneven.
      i. Do not allow adhesive to skin over.
      j. Walk boards into place and apply temporary ballast to ensure boards are adequately secured.

3.6 INSTALLATION OF SEPARATE LAYER COVER BOARD

   A. Note: This does not apply if the top layer of insulation is a composite board with factory-applied facing board.

   B. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
      1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
      2. At internal roof drains, conform to slope of drain sump.
         a. Trim cover board so that water flow is unrestricted.
      3. Cut and fit cover board tight to nailers, projections, and penetrations.
      4. Adhere cover board to substrate using adhesive according to FM Approvals’ RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
         a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 INSTALLATION OF ADHERED ROOFING

   A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

   B. Unroll roof membrane and allow to relax before installing.

   C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

   D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

   E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
F. Apply roof membrane with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
1. Install flexible walkways as per approved shop drawing, and at the following locations:
   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Locations indicated on Drawings.
   e. As required by roof membrane manufacturer's warranty requirements.
2. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
1. Manufacturer's technical representative to inspect as many times as necessary to ensure Warranty requirements are met.

C. Roof testing shall include but not be limited to: flood testing to a maximum depth of 2" at the high point and retaining water for a minimum of 24-hours, followed by infrared thermo-graphic imagery documentation.
D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER’S WARRANTY

A. WHEREAS ______________________________ of __________________________, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: _________________.
7. Warranty Period: <Insert time>.
8. Expiration Date: __________________.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. lightning;
   b. peak gust wind speed exceeding <Insert mph>;
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this ___________ day of __________________, ________________.

1. Authorized Signature: ____________________________________________.
2. Name: ________________________________________________________.
3. Title: __________________________________________________________.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Manufactured reglets with counterflashing.
   2. Formed roof-drainage sheet metal fabrications (gutters and downspouts).
   4. Formed wall sheet metal fabrications.
   5. Formed equipment support flashing.

B. Related Requirements:
   1. Section 07 42 13 “Aluminum Metal Plate Wall Panels”
   2. Section 08 41 13 “Aluminum-Framed Entrances & Storefronts”

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leak proof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions and counter flashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: Provide minimum 8 inch square piece of Fluoropolymer coil-coated finish (on aluminum-zinc alloy-coated steel sheet) in each scheduled color.

D. LEED Sustainable Design Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
1. Environmental Product Declaration: For each product.
2. Multi-Attribute Optimization declarations: for each product.
3. Raw Material Source and Extraction Reports: for each product.
4. Leadership Extraction Practices reports or certifications: for each product.
5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.
B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown, unless more stringent requirements are indicated.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Stack materials to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied PVDF finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA’s “The NRCA Roofing Manual” and SMACNA’s “Architectural Sheet Metal Manual” requirements for dimensions and profiles shown unless more stringent requirements are indicated.

1. Design copings and roof edge flashings in accordance with NRCA’s certified details to comply with California Building Code requirements for ANSI/SPRI ES-1 testing.

C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings capable of resisting the design pressure as indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
B. Stainless-Steel Sheet: ASTM A 240/A 240M Type 316, dead soft, fully annealed; with smooth, flat surface.
   1. Finish: 2D (dull, cold rolled) where concealed and No. 4 (polished directional satin) where exposed to public view.

C. Prefinished Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation.
   1. Prefinished Steel Sheet (only if indicated/scheduled on Drawings). Factory-finished by coil-coating process to comply with ASTM A 755.
   2. Surface: Smooth, flat. Mill phosphatize this sheet where it is not coil-coated and scheduled for field painting.
   3. Exposed Coil-Coated Factory-applied Finish:
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   4. Color: As selected by Architect from manufacturer's full range.
   5. Concealed (backside) Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

D. Aluminum-Zinc Alloy-Coated Steel Sheet according to ASTM A 792, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A 755. Possible tradenames: Galvalume or Zincalume.
   1. Coil-Coated Factory-applied Finish: Same as specified above.

E. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653, G90 (Z275) coating designation. Minimum 24 gage (0.0239 inch) thick base metal, unless otherwise noted.

2.3 UNDERLAYMENT MATERIALS

A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Kirsch Building Products, LLC.
      c. SDP Advanced Polymer Products Inc.
      d. Tyvek by DuPont.
      e. Or Equal.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Carlisle Coatings & Waterproofing Inc.
b. Henry Company.
c. Owens Corning.
d. Or Equal.

3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, with maximum lead content of 0.2 percent.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Self-Adhesive Flashing Membrane (SAFM) and Tape: Minimum 6 inch wide, 40 mil thickness, self-adhering, non-woven fabric reinforced SBS modified rubberized asphalt membrane: Protecto Wrap Co. “PW 100/40”; GCP Applied Technologies “Vycor V40” or approved equal. Provide other widths as needed.

F. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile indicated and required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fry Reglet Corporation.
   b. Hickman Company, W. P.
   c. IMETCO
   d. Or equal.

2. Material: Galvanized, 0.028 inch thick, (24 gage).

3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

5. Accessories:
   a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
   b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.


2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

2. Obtain field measurements for accurate fit before shop fabrication.

3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams for metals being soldered: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop-fabricate interior and exterior corners.

2. Exposed-to-View Gutter Material: Aluminum-Zinc Alloy-Coated Steel, prefinished.
5. Gutters with Girth up to 15 inches: 0.022 inch (0.56 mm)
6. Gutters with Girth 16 to 20 Inches: 0.028 inch (0.71 mm)
7. Gutters with Girth 21 to 25 Inches: 0.034 inch (0.86 mm)

B. Downspouts: Fabricate round galvanized pipe downspouts as per drawings and Section 05 50 00 “Metal Fabrications.” Minimum diameter of 3 inches.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate from the Following Materials:
   a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: As indicated on Drawings.
2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
3. Fabricate from the Following Materials:
   a. Aluminum-zinc alloy-coated steel sheet according to ASTM A 792: 22 gage.

C. Roof-to-Wall Transition / Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.

1. Galvanized Steel: 0.036 inch thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.030 inch thick.
E. Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.030 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.025 inch thick.

G. Roof-Drain Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.016 inch thick. (0.40 mm); or
   2. Copper: 12 oz./square foot.

2.9 WALL SHEET METAL FABRICATIONS

A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 3 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

B. Wall Expansion-Joint Cover: Fabricate from the following materials:
   1. Zinc-tin alloy-coated steel: 0.028 inch thick.

2.10 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.025 inch thick; or
   2. Galvanized Steel: 0.028 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:
   1. Stainless Steel: 0.025 inch thick; or
   2. Galvanized Steel: 0.040 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers’ written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

C. Where slip sheet is required (by manufacturer or SMACNA standards) separating sheet metal from underlayment, apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Seals.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer’s recommended methods for cleaning and neutralization.
5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous cleat or eave or apron flashing as detailed and reviewed in shop drawings.
3. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 40 feet apart. Install expansion-joint caps.

C. Downspout Attachment: Provide hangers with fasteners designed to hold downspouts securely to walls or steel posts. Locate hangers at top and bottom and at approximately 60 inches o.c.

D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer’s written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Install over layer of 30 mil. self-adhesive underlayment.
   1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
   2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant interlocking folded seam or blind rivets and sealant, or anchor and washer at 36-inch centers, unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 3 inches beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
3.9 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Work included: Furnishing and installing factory-fabricated roof hatch, factory fabricated ladder-assist post, and safety railing system.

B. Related Work:
   1. Section 07 54 19: PVC Roofing
   2. Section 07 62 00: Sheet Metal Flashing and Trim

1.2 SUBMITTALS

A. Product Data: Provide manufacturer’s complete product data for all items.

B. Shop Drawings: Show profiles, accessories, location, and dimensions.

C. Samples: Manufacturer to provide upon request; sized to represent material adequately.

D. Contract Closeout: Provide the manufacturer’s Warranty prior to the contract closeout.

1.3 PRODUCT HANDLING

A. All materials shall be delivered in manufacturer’s original packaging. Remove protective wrapping immediately after installation. Store materials in a dry, protected, well-ventilated area.

1.4 JOB CONDITIONS

A. Verify that other trades with related work are complete before installing roof hatch(es).

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Coordinate installation with roof membrane and roof insulation manufacturer’s instructions before starting.

D. Observe all appropriate OSHA safety guidelines for this work.

1.5 WARRANTY

A. Manufacturer’s standard warranty: Materials shall be free of defects in material and workmanship for a period of five years from the date of final completion. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with specified requirements, provide Bilco Company Model F-50 hatch, ladder-assist post, and safety railing system, or comparable products by one of the following:
   1. Babcock-Davis
   2. Nystrom Inc.
   3. O’Keeffe’s Inc.
   4. Milcor Inc.
5. Or approved equal.

2.2 ROOF HATCH

A. Type and Size: Furnish and install where indicated on plans an aluminum roof hatch, 48 inch wide by 48 inch long. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.

B. Performance Characteristics:
   1. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
   2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
   3. Operation of the cover shall not be affected by temperature.
   4. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.

C. Cover: Shall be 11 gauge (2.3mm) aluminum with a 3” beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

D. Cover Insulation: Shall be fiberglass of 1” (25mm) thickness, fully covered and protected by an 18 gauge (1mm) aluminum liner.

E. Curb: Shall be 12” in height and of 11 gauge (2.3mm) aluminum. The curb shall be formed with a 3-1/2” flange with holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system (or equal), including stamped tabs, 6” on center, to be bent inward to hold single ply roofing membrane securely in place.

F. Curb Insulation: Shall be rigid, high-density fiberboard of 1” thickness on outside of curb.

G. Lifting Mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe, welded to the curb assembly (for aluminum construction).

H. Hardware:
   1. Provide heavy-duty pintle hinges.
   2. Cover shall be equipped with a spring latch with interior and exterior turn handles.
   3. Roof hatch shall be equipped with interior and exterior padlock hasps.
   4. The latch strike shall be a stamped component bolted to the curb assembly.
   5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" diameter red vinyl grip handle to permit easy release for closing.
   6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed.
   7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

I. Factory metal finish shall be mill finish aluminum.

2.3 LADDER-ASSIST POST

A. Ladder-Assist Post: Roof-hatch manufacturer’s standard device for attachment to roof-access ladder. Provide at each hatch.
   1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
   2. Height: 42 inches above finished roof deck.
5. Finish: Manufacturer's standard baked enamel or powder coat.

2.4 SAFETY RAILING SYSTEM

A. Basis-of-Design: Bilco Co. Bil-Guard 2.0 Model RL2-S Safety Railing System.
   1. Posts and rails are 1¼” schedule 40 pipe in 6061 T6 aluminum alloy. Curb mounting brackets and teardrop brackets are 6063 T5 aluminum extrusion. Lock assembly is cast aluminum and gate spring hinges and all fasteners are type 316 stainless steel. Hatch rail system satisfies the requirements of OSHA 29 CFR 1910.29 and meets OSHA strength requirements. Finish shall be safety yellow powdercoat paint finish. Manufacturer shall provide a 5-year warranty against defects in material and workmanship. Provide self-closing and locking gate.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that roof hatch installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Coordinate with installation of roofing and related metal flashings.
B. The installer shall check as-built conditions and verify the manufacturer’s roof hatch details for accuracy to fit the application prior to fabrication. Comply with the roof accessories manufacturer's installation instructions.
C. Furnish mechanical fasteners consistent with the roof requirements. Manufacturer shall furnish fasteners necessary for ladder-assist post to ladder.
D. Apply bituminous paint on metal surfaces of roof hatch to be in contact with cementitious materials and dissimilar metals.
E. Install Ladder-assist post to ladder per manufacturer’s instructions.

3.3 ADJUSTING AND CLEANING

A. Adjust movable parts for smooth and proper operation.
B. Test-operate units with operable components. Clean and lubricate joints and hardware.
C. Clean exposed surfaces per manufacturer’s written instructions. Touch-up damaged metal coatings.

END OF SECTION
SECTION 07 84 13
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For sealants, indicating VOC content.
   2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
   1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer’s written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in “Penetration Firestopping Systems” Article. Provide rated systems complying with the following requirements:
   a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      1) UL in its “Fire Resistance Directory.”
      2) Intertek Group in its “Directory of Listed Building Products.”
      3) FM Approval in its “Approval Guide.”

B. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

C. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group’s “Directory of Listed Building Products” under “Firestop Systems.”

D. Where FM Approval-approved systems are indicated, they refer to design numbers listed in FM Approval’s "Approval Guide" under "Wall and Floor Penetration Fire Stops."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M Fire Protection Products.
   c. Hilti, Inc.
   d. RectorSeal.
   e. Specified Technologies, Inc.
   f. Tremco, Inc.
B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
   2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
   3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
   1. Sealant shall have a VOC content of 250 g/L or less.
   2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
   1. Permanent forming/damming/backing materials.
   2. Substrate primers.
   3. Collars.
   4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.


2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer’s written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
C. Install fill materials by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories and
penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and
penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce
smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the
words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not
less than 3 inches high and with minimum 0.375-inch strokes.
1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of
wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or
plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of
penetration firestopping system edge so labels are visible to anyone seeking to remove
penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type
labels with adhesives capable of permanently bonding labels to surfaces on which labels are
placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building
Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

C. At rated wall assemblies, above dropped ceilings and at raised floor systems, Contractor to
provide and install marking and identification of rated walls using the suggested wording, "FIRE
AND/ OR SMOKE BARRIER. SEAL AND PROTECT ALL OPENINGS", with a minimum of 3"
(76 mm) high lettering in a 3/8" (9.5 mm) stroke on a contrasting background within 15'-0" at the
end of each rated wall and at intervals not exceeding 30'-0" maximum.
1. Marking tape manufacturer: M & I Tape (www.mnitape.com), or approved equal.
2. Other legible labels as specified in 3.4C below, or spray-painting through stencils may be
submitted for review.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to
ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed
because of testing, repair or replace penetration firestopping system to comply with
requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after
inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and
with cleaning materials that are approved in writing by penetration firestopping system
manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that
penetration firestopping systems are without damage or deterioration at time of Substantial
Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION
SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Provide joint sealants, for interior and exterior joints not specified elsewhere, with backing rods and accessories as required for complete installation.
   1. Joint sealants include sealants and caulking as indicated.

B. Related Sections:
   1. Section 07 54 19: PVC Roofing
   2. Section 07 62 00: Sheet Metal Flashing and Trim
   3. Section 07 84 13: Penetration Firestop Systems
   4. Section 08 80 00: Glazing, for glazing sealants
   5. Section 09 30 00: Ceramic and Stone Tiling
   6. Sections 09 91 13 and 09 91 23: Painting
   7. Section 32 13 73: Concrete Paving Joint Sealants

1.2 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Select materials for compatibility with joint surfaces and indicated exposures.
   2. Where not indicated, select modulus of elasticity and hardness or grade recommended by manufacturer for each application indicated.
   3. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Product Data: Furnish manufacturer's descriptive literature for each product specified.

B. Samples: Furnish samples of each type of exposed joint sealer in required colors, 2 inch long by ½ inch wide each.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.

F. Sustainable Design (LEED) Submittals:
   1. Product Data: For sealants used inside the weatherproofing system including printed statement indicating VOC content complies with the VOC content requirements of SCAQMD’s Rule 1168 and the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic
Emissions from Various Sources Using Small-Scale Environmental Chambers" for each product used. Indicate VOC content in g/L. Comply with Section 01 81 13 for Low-Emitting Materials, Adhesives and Sealants.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm with minimum five years successful experience on projects of similar type and size, using specified products.
   1. Installers shall be familiar with proper application procedures to ensure maximum joint sealer expansion and contraction capabilities.

B. Source Limitations: Obtain each type of sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Use ASTM C 1087 or manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Submit not fewer than 4 pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   4. For materials failing tests, obtain joint-sealant manufacturer's written instruction for corrective measures including use of specially formulated primers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, cure time, and mixing instructions.

1.6 SITE CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

B. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer.

1.7 WARRANTY

A. Special Warranty: Repair or replace joint sealants which fail to perform as intended, because of leaking, crumbling, hardening, shrinkage, bleeding, sagging, staining and loss of adhesion.
   1. Special Warranty Period: Five years.
   2. Manufacturer's standard warranty covering sealant materials.
   3. Applicator's standard warranty covering workmanship.

B. Non-Staining Limited Warranty for Silicone Exterior Sealant: Silicone manufacturer shall provide 20-years non-staining warranty complying with ASTM C 1248.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

Subject to compliance with specified requirements, provide the named product or a comparable product approved in advance by the Architect.

2.2 MATERIALS

A. Elastomeric Sealants:
   1. Single Component, Non-Staining, Low Modulus Silicone Sealant: ASTM C920 Type S, Class 50, Use NT, Grade NS; minimum 50% expansion and compaction capability.
      a. Provide at exterior building locations not exposed to traffic, such as walls.
      b. Manufacturers:
         1) BASF Building Systems; Omniseal 50
         2) Dow Corning Corp / 791 or 795.
         3) GE Advanced Materials - Silicones; SilPruf NB SCS9000
         4) Pecora Corp / 864NST or 895NST.
         5) Tremco / Spectrem 2 or 3.

      a. Refer also to Section 32 13 73: Concrete Paving Joint Sealants.
      b. Provide following at traffic bearing locations, such as paving and interior and exterior horizontal joints exposed to pedestrian and vehicular traffic.
      c. Manufacturers:
         1) BASF Building Systems; Sonolastic NP 2.
         2) Pecora Corporation; Dynatred.
         3) Sika Corporation; Sikaflex - 2c EZ Mix.
         4) Tremco Incorporated; Dymeric 240FC.

   3. Mildew-Resistant Silicone Rubber Sealant: Acid-Curing, Single-Component, ASTM C920, Type S, Grade NS, Class 25, compounded with fungicide, specifically for mildew resistance and recommended for interior joints in wet areas.
      a. Provide at interior joints in wet areas (toilet rooms, food service areas or break rooms, custodial rooms)
      b. Manufacturers:
         1) Dow Corning Corporation; 786 Mildew Resistant.
         2) GE Advanced Materials - Silicones; Sanitary SCS1700.
         3) Pecora Corporation; 860.
         4) Tremco Incorporated; Tremsil 200 Sanitary.

B. Non-Elastomeric Sealants:
   1. Acrylic-Emulsion Sealant: ASTM C834, Type OP, Grade NF, acrylic or latex-rubber-modified acrylic sealant, permanently flexible, non-staining and non-bleeding; recommended for general interior exposure; compatible with paints specified in Section 09910.
      a. Provide at general interior applications. Example: Interior gypsumboard.
      b. Manufacturers:
         1) Pecora Corp. / AC-20+.
         2) BASF Building Systems; Sonolac.
         3) Tremco / Tremflex 834.

C. One-Part Butyl Rubber Base Sealant complying with Federal Specification TT-S-001657, Type I and ASTM C 1085. Use: All exterior sheet metal flashing laps and intermediate joints with less than 10% movement.
   1. Tremco / Butyl Caulk
3. W. R. Meadows, Inc / Sealight Elastomeric Butyl Caulk
4. Adco Products, Inc. / Adco B-100 butyl sealant
5. Pecora / BC-158

D. Concealed Acoustical Sealant, non-drying, non-hardening and permanently flexible complying with ASTM D217. This type is not paintable. Use: Provide at all hidden-from-view joint openings and non-exposed areas required to meet sound transmission class values, and as indicated on Drawings.
1. ADCO BP400 Bedding Sealant, by Adco Products, Inc.
2. Ohio Sealants, Inc. (OSI); SC-170NS Acoustical Sound Sealant.
3. BA-98 by Pecora Corp.
4. Tremco Incorporated; Acoustical Sealant.

E. Exposed Acoustical Sealant (that is to be painted): This product available in white and gray only. Product shall comply with ASTM C 834. Use: Provide at all exposed areas and acoustical sealants to be painted, where required to meet sound transmission class values, and as indicated on Drawings.
1. SC-175 water-base sound sealant, by Ohio Sealant, Inc.
2. AC-20FTR, by Pecora Corporation.

F. Construction Adhesives: Macklanburg/Duncan Co."LockBond"; Chapco (Chicago Adhesive Products Co.) "SafeSet" Type, or approved equal. Type as required to suit substrates.

G. Preformed, Pre-Compressed, Self-Expanding, Sealant System with Silicone Pre-Coated Surface. Watertight, Exterior and Interior Above-Grade Wall Joints: “Seismic Colorseal” as manufactured by Emseal Joint Systems (or approved equal), and as indicated on drawings for any vertical expansion joint locations.
1. Preformed sealant shall be silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system. Expanding foam to be cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.
2. Material shall be capable of movements of +50%, -50% (100% total) of nominal material size.
3. Select the sealant system model appropriate to the movement and design requirements at each joint location that meet the project specification as defined by the Structural Engineer and Architect.
4. Directional changes and terminations into horizontal plane surfaces to be provided by factory-manufactured universal-90-degree single units containing minimum 12-inch long leg and 6-inch long leg or custom leg on each side of the direction change.

H. Pipes and conduits penetrating underground or waterproofed walls: Sealant compatible with waterproofing system installed, approved by waterproofing manufacturer.

I. Miscellaneous Materials:
1. Primers/Sealants: Non-staining types recommended by joint sealer manufacturer for joint surfaces to be primed or sealed.
2. Joint Cleaners: Non-corrosive types recommended by joint sealer manufacturer; compatible with joint forming materials.
3. Bond Breaker Tape: Polyethylene tape as recommended by joint sealer manufacturer where bond to substrate or joint filler must be avoided for proper performance of joint sealer.
4. Sealant Backer Rod: Compressible polyethylene foam rod or other flexible, permanent, non-staining, durable, non-absorptive material as recommended by joint sealer manufacturer for compatibility with joint sealer, based on field experience and lab testing.
   a. Oversize backer rod minimum 30% to 50% of joint opening.
b. **Cylindrical Sealant Backings:** ASTM C 1330, Type, size and density to control sealant depth and produce optimum sealant performance.

J. **Colors:*** Provide colors indicated or as selected by Architect from manufacturer's full range of colors.
   1. Custom Colors: Custom colors may be required at exterior walls.

K. **Compatibility:** Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

L. **Stain-Test-Response Characteristics:** Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for this Project.

M. **Emissions Limits:**
   1. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 “Adhesives Material Application Operations.”
   2. For field applications that are inside the weatherproofing system, comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Emissions from Indoor Sources Using Environmental Chambers."

2.3 **SPECIAL FINISHES**

A. Special finishes and fluoropolymer coatings such as PVDF Hylar, Kynar, Duranar, etc. shall be given special consideration by the contractor for sealant adhesion and compatibility to adjacent surfaces. Only products recommended and tested by manufacturer per ASTM C 794 for such surfaces shall be used.

2.4 **OTHER MATERIALS**

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

**PART 3 - EXECUTION**

3.1 **PREPARATION**

A. Prepare joint surfaces in accordance with ASTM C1193 and as recommended by joint sealer manufacturer.

B. Clean joint surfaces immediately before installation of joint sealer; remove dirt, insecure materials, moisture and other substances which could interfere with bond of joint sealer.

C. Prime or seal joint surfaces where recommended by joint sealer manufacturer; do not allow primer/sealer to spill or migrate onto adjoining surfaces.

D. Ensure protective coatings on surfaces in contact with joint sealants have been completely stripped.

3.2 **INSTALLATION**

A. Comply with manufacturer’s printed instructions and ASTM C1193, except where more stringent requirements are shown or specified.
B. Set sealant backer rods at proper depth or position in joint to coordinate with other work, including installation of bond breakers and sealant; do not leave voids or gaps between ends of backer rods.
   1. Do not stretch, twist, puncture or tear backer rods.

C. Install bond breaker tape where required by manufacturer’s recommendations to ensure joint sealants will perform properly.

D. Size materials to achieve required width/depth ratios.

E. Employ installation techniques that will ensure joint sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete “wetting” of bond surfaces equally on opposite sides.

F. Joint Configuration: Fill sealant joint to a slightly concave surface, slightly below adjoining surfaces, unless otherwise indicated or approved by Architect. Tool joints to match approved samples. Leave sealant surface neat and smooth.

G. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture or dirt.

H. Install joint sealants to depths recommended by joint sealer manufacturer but within the following general limitations, measured at center (thin) section of bead.
   1. Horizontal Joints: 75% width with minimum depth of 3/8”.
   2. Elastomeric Joints: 50% width with minimum depth of 1/4”.
   3. Non-Elastomeric Joints: 75% to 125% of joint width.

I. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces.
   1. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, and not to damage finished surfaces.

J. Cure joint sealants in compliance with manufacturer’s instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

K. Maintain finished joints free of embedded matter, ridges and sags.

3.3 SEALANT TESTING

A. Contractor shall perform stain testing in-lab to stone or absorbent tile or masonry substrates. Sealant manufacturer shall do this testing at no cost on primed and non-primed surfaces, as well as tab adhesion ASTM C 7190 testing following immersion.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION
SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes standard hollow metal doors and frames.

B. Related Sections:
   1. Section 08 71 00 “Door Hardware”
   2. Section 08 80 00 “Glazing” for glass within doors and frames.
   3. Section 08 31 13 “Access Doors and Frames.”
   4. Division 9 Sections “Painting” for field painting hollow metal doors and frames.
   5. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. Sustainable Design Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

C. Product Test Reports: Based on evaluation of comprehensive sound-rating and fire tests performed by a qualified testing agency, for each type of sound-control door assembly.

D. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Sound Rating: Provide sound-control (acoustical) door assemblies that have been fabricated and tested as sound-retardant units, are identical to assemblies tested according to ASTM E 90 by an independent testing agency, and have the indicated certified STC rating according to ASTM E 413.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

   1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

   1. Amweld Building Products, LLC.
   2. Benchmark; a division of Therma-Tru Corporation.
   3. Ceco Door Products; an Assa Abloy Group company.
   4. Curries Company; an Assa Abloy Group company.
   5. Fleming Door Products Ltd.; an Assa Abloy Group company.
7. Mesker Door Inc.
8. Pioneer Industries, Inc.
10. Steelcraft; an Allegion brand.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated or Galvannealed Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic (galvanizing) coating.
   1. Use at all exterior and public restrooms.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Division 8 Section "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
   1. Design: Flush panel unless otherwise indicated.
   2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core.
5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.

B. Exterior Doors: Face sheets fabricated from metallic-coated (galvanized) steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
2. Door Face Steel Thickness: Manufacturers Standard Gage (MSG) No. 16.
3. Provide welded top cap, ground smooth.

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).
2. Door Face Steel Thickness: Manufacturers Standard Gage (MSG) No. 18.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet (14 gage).

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless metallic-coated sheet where indicated.
1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as face welded or full profile welded unless otherwise indicated.
3. Frames for Level 2 Steel Doors: 0.053-inch-thick steel sheet (16 gage).
4. Frames for Wood Doors: 0.053-inch-thick steel sheet.
5. Frames for Borrowed Lights: 0.053-inch-thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:
1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS
A. Provide hollow metal panels and transom panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS
A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 LOUVERS
A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
   1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.
B. Exterior Louvers: Provide inverted V or Y type with minimum 50% net-free opening (before screening). Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed removable insect screens secured to room side. Provide aluminum wire cloth, 18 by 18 or 18 by 16 mesh, for insect screens.

2.9 ACCESSORIES
A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.
C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.10 FABRICATION
A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
C. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and Mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
   b. Compression Type: Not less than two anchors in each jamb.
   c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.11 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating. Apply at the manufacturing factory.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      b. Install frames with removable glazing stops located on secure side of opening.
      c. Install door silencers in frames before grouting.
      d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      f. Field- or factory-apply bituminous coating to backs of frames that are filled with grout.

   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

   3. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

   4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
      a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jambs and Head: 1/8 inch, plus or minus 1/16 inch.
      b. Between Edges of Pairs of Doors: 1/8 inch, plus or minus 1/16 inch.
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

D. Glazing: Comply with installation requirements in Division 8 Section “Glazing” and with hollow metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated (Galvanized) Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer’s written instructions.

END OF SECTION
SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Solid-core doors and transom panels with wood-veneer and MDO faces.
   2. Factory finishing flush wood doors.
   3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:
   1. Section 08 71 00 “Door Hardware”
   2. Section 08 80 00 “Glazing” for glass view panels in flush wood doors.
   3. Section 09 91 23 "Interior Painting” for field finishing doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finish specifications.

B. Sustainable Design Submittals:
   1. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
      a. Environmental Product Declaration: for each product.
      b. Multi-Attribute Optimization declarations: for each product.
      c. Raw Material Source and Extraction Reports: for each product.
      d. Leadership Extraction Practices reports or certifications: for each product.
      e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
   2. Product Data: For adhesives, indicating that product contains no urea formaldehyde.
   3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials. Comply with Section 01 81 13 requirements.
   4. Product Data: For composite wood products, indicating that product contains no urea formaldehyde.
   5. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
   1. Dimensions and locations of blocking.
   2. Dimensions and locations of mortises and holes for hardware.
   3. Dimensions and locations of cutouts.
   4. Undercuts.
   5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.

D. Samples for Verification:
   1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
   2. Corner sections of factory-finished doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
      a. Provide Samples for each species of veneer and solid lumber required.
      b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
   3. Frames for light openings, 6 inches long, for each material, type, and finish required.
   4. After 8 x 10 sample is approved, and before manufacturing doors for the project, submit one entire transparent-finish door in Grade and Finish specified for each style. Approved samples may later be installed in building.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification or WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.

B. Manufacturer Qualifications: Company specializing in manufacturing the product specified in this section, with not less than three years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABS-American Building Supply- Doormerica.
   2. Algoma Hardwoods, Inc.
   3. Ampco Products, LLC.
   4. Chappell Door Co.
   5. Eggers Industries.
   7. Graham Wood Doors; an Assa Abloy Group company.
   8. Haley Brothers, Inc.
   10. Lambton Doors.
   11. Marshfield Door Systems, Inc.
   12. Mohawk Flush Doors, Inc.
   15. Poncraft Door Company.
   17. VT Industries, Inc.

B. Source Limitations: Obtain all flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
   1. Provide AWI Quality Certification or WI Certified Compliance Labels indicating that doors comply with requirements of grades specified.

B. Adhesives: Do not use adhesives that contain urea formaldehyde. Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. VOC Limits:
   1. Ultra-Low Formaldehyde: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde resins as described in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
   2. Use products that meet the VOC content limits of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."

E. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

F. Particleboard-Core Doors:
   1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2.
   2. Particleboard: (Possible for LEED credit) Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
   3. Blocking: Provide wood blocking in particleboard-core doors as follows:
a. 5-inch top-rail blocking, in doors indicated to have closers.
b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
c. 5-inch midrail blocking, in doors indicated to have exit devices.

4. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

G. Structural-Composite-Lumber-Core Doors:
   a. Screw Withdrawal, Face: 700 lbf.
   b. Screw Withdrawal, Edge: 400 lbf.

H. Mineral-Core Doors:
1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware and as follows:
   a. 5-inch top-rail blocking.
   b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
   c. 5-inch midrail blocking, in doors indicated to have armor plates.
   d. 5-inch midrail blocking, in doors indicated to have exit devices.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:
1. Grade: Premium with AA grade veneer.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
10. Exposed Vertical and Top Edges: Applied wood-veneer edges of same species as faces and covering edges of faces - edge Type B.
11. Core: Particleboard or Structural composite lumber.
12. Construction: Five Ply. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces to be bonded to core using a hot press.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
1. Wood Species: Same species as door faces.
2. Profile: Recessed tapered beads or Manufacturer's standard shape.
2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
   1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
   2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
   1. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
   2. Seal door top edge with color sealer to match door facing.

B. Factory finish doors that are indicated to receive transparent finish.

C. Transparent Finish:
   1. Grade: Premium.
   2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" Provide one of the following:
      a. System 5, conversion varnish
      b. System 9, UV curable, acrylated epoxy, polyester, or urethane
      c. System 10, UV curable, water based
      d. System 11, catalyzed polyurethane.
   4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
   5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.
   1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION
SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes access doors for installation in the following types of construction:
   1. Exterior Plaster
   2. Gypsum Board
   3. Ceramic Tile

B. Provide fire-rated access doors where indicated or scheduled. Door rating to match that of wall or ceiling being pierced.

1.2 RELATED DOCUMENTS

A. Section 09 24 00: Exterior Cement Plastering

B. Section 09 29 00: Gypsum Board

C. Section 09 91 23: Painting, for finish painting of primed units.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 1:
   1. Product data in form of manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions, and directions for installation of anchorage, devices.
      a. Include a complete Schedule, including types, actual locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions, and other data pertinent to installation. Coordinate schedule with mechanical and electrical access requirements.
   2. Shop Drawings showing fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage and accessory items.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain wall and ceiling (drywall) access doors for entire project from one source from a single manufacturer.

B. Fire-Resistance Rating: Wherever a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating shown. Provide UL or equal label on each fire-rated access door. Provide access doors having the same or greater fire rating as the surface being pierced. Comply with NFPA 80. Comply with NFPA 252 or UL 10B for vertical access doors and frames, and ASTM E 119 or UL263 for horizontal access doors and frames.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

D. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.
1.5 PROJECT CONDITIONS

A. Verification: Verify doors to receive locks with Architect and Owner prior to ordering. Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.

B. Special-size access doors: Use where required or requested; indicate on submittal schedule.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering access doors that may be incorporated in the work include, but are not limited to, the following:
   1. Cendrex
   2. Dur-Red Products
   3. J.L. Industries
   6. Inryco/Milcor, Inc.
   7. The Williams Brothers Corp.
   8. Nystrom

2.2 MATERIALS AND FABRICATION

A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.

B. Metallic-Coated Steel Sheet: ASTM A 653 Commercial Steel (CS) with A60 (ZF180) zinc-iron alloy (galvannealed coating or G60 (Z180) mill-phosphatized zinc coating, stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924.
   1. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

C. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to gypsum board thickness.

D. Plaster Beads: Casing bead formed from 0.0299-inch zinc-coated steel sheet with flange formed out of expanded metal lath and in size to suit plaster thickness.

E. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

F. Frames: Fabricate from 16-gauge steel. Provide mounting holes in frames to attach to metal framing in plaster and gypsum board.
   2. Plaster: Furnish zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.

G. Recessed Access Doors and Trimless Frames: Provide this type at all gypsum board walls and ceilings. Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
   1. Trimless, Flush Access Doors for Gypsum Board: Provide concealed edge trim type and recessed pan for infill with 5/8” Type X gypsum board.
   2. For exterior recessed doors with plaster infill, provide self-furring galvanized expanded-metal lath attached to door panel.
H. Flush Panel Doors: Fabricate from not less than 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees.

I. Fire-Rated Doors: For fire-rated units, provide manufacturer's insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.
   1. Fire-Rated Wall Type: Williams Brothers Model WB-FR "Standard" or approved equal.
   2. Fire-rated for gypsum board ceilings: Williams Brothers Model WB-FRC or approved equal.

J. Locking and Latching Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.
   1. Verify and coordinate locking requirements with District and Architect prior to submittal. Provide one cylinder lock per each access door. Furnish 2 keys per lock and key all locks alike, unless otherwise scheduled.
   2. For bid purposes, assume all doors to have key lock.
   3. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

K. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Correct unsatisfactory conditions before installing products of this section. Commencement of installation indicates acceptance of conditions.

B. Comply with manufacturer's instructions for installation of access doors.

C. Coordinate installation with work of other trades.

D. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces. Install doors flush with adjacent finish surfaces or recessed to receive finish material, such as plaster.

3.2 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

C. Clean and make ready all prime-painted doors for finish painting under Section 099123 of these specifications.

END OF SECTION
SECTION 08 36 13
SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes electrically operated sectional doors.
B. Related Requirements:
   1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS
A. Product Data: For each type and size of sectional door and accessory.
   1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. Include diagrams for power, signal, and control wiring.
C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
   1. Frame for paneled door sections; of each width of stile and rail required.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer.
B. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS
A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Failure of components or operators before reaching required number of operation cycles.
      c. Faulty operation of hardware.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
      e. Delamination of exterior or interior facing materials.
   2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
   1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
   1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
   2. Testing: According to ASTM E330 or DASMA 108 for garage doors and complying with the acceptance criteria of DASMA 108.
   3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
      a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
      b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.

C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to California Building Code.

2.3 DOOR ASSEMBLY

A. Full-Vision Aluminum Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. C.H.I. Overhead Doors, Inc.
c. Overhead Door Corporation.
d. Raynor.
e. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.

D. Track Configuration: High-lift track. Track configuration and hardware shall cause the door to rise vertically for some distance, as identified in the drawings, to create lift-clearance above the door opening to the underside of the horizontal tracks.

E. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.

F. Roller-Tire Material: Manufacturer’s standard.

G. Locking Devices: Equip door with locking device assembly.
   1. Locking Device Assembly: locking bars, operable from inside and outside, with cylinders.

H. Counterbalance Type: Torsion spring counterbalance mechanism with high strength.

I. Electric Door Operator:
   1. Usage Classification: Light duty, up to 10 cycles per hour.
   2. Operator General: Provide electric door operator provided by door manufacturer for door with operational life specified complete with electric motor and factory pre-wired motor controls, starter, gear-reduction unit, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation. Comply with NFPA 70. Provide solenoid-operated brake.
   3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
      a. Sensor Edge Bulb Color: As selected by Architect from manufacturer’s full range.
   7. Control Station: Interior-side mounted as indicated on Drawings.
   8. Other Equipment: Audible signaling.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 ALUMINUM DOOR SECTIONS

A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, 1/4-inch-minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.
   1. Aluminum: ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; minimum thickness 0.075 inch for door section 1-3/4 inches deep, and as required to comply with requirements.
   2. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
   3. Provide reinforcement for hardware attachment.
   4. Horizontal rails shall form a weathertight tongue and groove joint.
B. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with double pane glass set in snap-in glazing bead and hot melt adhesive, and with removable extruded-vinyl or aluminum stops.
   1. Glass: Tempered, Low-E coated, tint or clear to match adjacent window glazing.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
   2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
   3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
      a. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.7 HARDWARE

A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch-nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch-diameter roller tires for 3-inch-wide track and 2-inch-diameter roller tires for 2-inch-wide track.

D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with 13 gage galvanized-steel lifting handle on interior side of door, mounted to bottom bracket, finished to match door.

E. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

F. Provide slide bolt door lock: #2 end stile type, located on the interior left side.

2.8 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A229/A229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
B. **Weight Counterbalance:** Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.

C. **Cable Drums and Shaft for Doors:** Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.

D. **Cables:** Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1 with cable safety factor of at least 7 to 1.

E. **Cable Safety Device:** Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

F. **Bracket:** Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

G. **Bumper:** Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.9 **ELECTRIC DOOR OPERATORS**

A. **General:** Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

B. **Usage Classification:** Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. **Door-Operator Type:** Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
   1. **Jackshaft, Side Mounted:** Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.

D. **Motors:** Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
   1. **Electrical Characteristics:**
      a. **Phase:** Three phase.
      b. **Volts:** 220v V.
      c. **Hertz:** 60.
   2. **Motor Size:** 3/4 HP minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
   3. **Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring:** Manufacturer's standard unless otherwise indicated.
   4. **Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.**
   5. **Use adjustable motor-mounting bases for belt-driven operators.**
E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
   1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
      a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
   2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
      a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
   1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.


I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible Signal: Provide audible alarm in compliance with regulatory requirements for accessibility.

2.10 ALUMINUM REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF or FEVE resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Match finish of adjacent storefront.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks:
   1. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Power-Operated Door: Install according to UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION
SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Exterior and interior storefront framing.
   2. Storefront framing for window walls.
   3. Exterior manual-swing entrance doors and door-frame units.
   4. Exterior Curtain Walls

B. Related Requirements:
   1. Section 07 92 00 “Joint Sealants”.
   2. Section 08 71 00 “Door Hardware”.
   3. Section 08 80 00 “Glazing”.
   4. Section 13 42 73 “Integrated Interior Assemblies” (Interior Modular Partitions)

1.3 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Deferred Submittal: To be done for Curtain Wall and Storefront. Contractor and Architect shall conform to Division of State Architect (DSA) requirements for submitting these documents for deferred approval. Refer to Section 01 33 00 “Submittal Procedures” for such procedures.
   1. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation

B. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
   2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
      a. Joinery, including concealed welds.
      b. Anchorage.
      c. Expansion provisions.
      d. Glazing.
      e. Flashing and drainage.
   3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
1. Joinery, including concealed welds.
2. Anchorage.
5. Flashing and drainage.

F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Sustainable Design (LEED) Submittals:
1. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   a. Environmental Product Declaration: For each product.
   b. Multi-Attribute Optimization declarations: for each product.
   c. Raw Material Source and Extraction Reports: for each product.
   d. Leadership Extraction Practices reports or certifications: for each product.
   e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
2. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

B. Product Test Reports: For aluminum-framed entrances, curtain wall and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Source quality-control reports.

D. Sealant Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating that materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with sealants; include joint sealant manufacturer's written interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

E. Sample Warranties: For special warranties.

F. Manufacturer Seismic Qualification Certificate: Submit certification that aluminum-framed entrances and storefronts shall withstand seismic forces defined according to ASCE/SEI 7.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.


D. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
      e. Failure of operating components.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty for PVDF or FEVE Finish: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, peeling, or chipping.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS FOR STOREFRONT

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, sway, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Loads: As indicated on drawings and below.

C. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

D. Structural: Test according to ASTM E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Dead Loads: Provide entrance and storefront-system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
   1. Provide a minimum 1/8-inch clearance between members and top of glazing or other fixed part immediately below.
   2. Provide a minimum 1/16-inch clearance between members and operable doors.

F. Live Loads: Provide entrance and storefront systems, including anchorage, that accommodate the supporting structures’ deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

G. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of CBC or the ASCE 7, Minimum Design Loads for Buildings and Other Structures, 6.4.2, “Analytical Procedure,” whichever are more stringent.

H. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
   1. Fixed Framing and Glass Area:
      a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
   2. Entrance Doors:
      a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
      b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

I. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. Water leakage is defined as follows:
      a. Uncontrolled water infiltrating systems or appearing on systems’ normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
J. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
   2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
      a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
      b. Low Exterior Ambient-Air Temperature: 0 deg F.
      c. Interior Ambient-Air Temperature: 75 deg F.

L. Glazing: Physically isolate glazing from framing members.

M. Forced-entry resistance must meet the requirements of ASTM F 588 Performance Grade 10.

N. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

2.2 MANUFACTURERS AND BASIS-OF-DESIGN

A. Manufacturers: Subject to compliance with specified requirements, provide products by one of the following, or approved equal:
   1. Arcadia (Basis-of-Design Products)
   2. EFCO Corporation.
   4. Oldcastle BuildingEnvelope.
   5. United States Aluminum
   6. Or equal.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including accessories, from single manufacturer.

2.3 STOREFRONT SYSTEM FRAMING

A. Basis-of-Design Systems:
      a. Type: 2-1/4" x 4-1/2", offset glazed.
   2. Interior: Arcadia AR-450+. Use everywhere except where modular partitions (Section 13 42 73- "DIRTT" system) is indicated, and where STC-rated systems are indicated.
      a. Type: 2" x 4-1/2" center glazed.
   3. Interior STC-rated: Arcadia AG451STC. Use where STC-rated systems are indicated.
      a. Type: 2" x 4-1/2", center-glazed, STC 37.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:
   1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
      a. Sheet and Plate: ASTM B 209.
      b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Use at Curtain Wall. Manufacturer’s standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
   a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 CURTAIN WALL SYSTEM

A. Basis-of-Design System: ArcadiaT500-OPG-1900. Use at front entry for segmented curve.
   1. 2-1/4” x 7” captured system.
   2. Arcadia T500 Series is a self-supporting curtain wall, with pressure plate and covers attached to the tongue of back member.
   3. System shall provide for two-piece horizontal framing so that all fasteners at intersection of horizontal and vertical members will be concealed.
   4. There shall be no exposed fasteners at perimeter sections.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 “Quality Requirements,” to design glazed aluminum curtain walls.

C. Performance Requirements:
   1. Limit air leakage through assembly to 0.06 CFM/min/sq. ft. of wall area at 6.24 PSF as measured in accordance with ASTM E283.
   2. Water Resistance: No water leakage when measured in accordance with ASTM E331 with a static test pressure of 15PSF.
   3. Dynamic Water Resistance: No water leakage, when measured in accordance with AAMA 501.1-94 with a dynamic test pressure of 15 PSF.
   4. Uniform Load Deflection under positive and negative design wind pressure normal to the plane of the wall, shall not exceed L/175 of the clear span or 3/4”, when tested in accordance with ASTM E 330.
   5. Uniform Load Structural at a pressure 1.5 times the design wind pressure in accordance with ASTM E 330.
   6. System shall not deflect more than 1/8” at the center point, or 1/16” at the center point of a horizontal member, once deadload points have been established.
   7. System shall accommodate expansion and contraction movement due to surface temperature differential of 180 degrees F.
   8. Condensation Resistance Factor (CRF) in accordance with AAMA 1503.1-88 shall not be less than 55.
   9. Thermal Transmittance (U-Value) in accordance with AAMA 1503.1-88 shall not be more than .65 BTU,hr/degree F/SF.
   10. Seismic testing shall conform to AAMA recommended static test method for evaluating performance of curtain walls and storefront wall systems due to horizontal displacements associated with seismic movements and building sway.
   11. Sound transmission in accordance with ASTM E 90.

2.5 ENTRANCE DOOR SYSTEMS

A. Manufacturer’s standard heavy-duty type glazed exterior doors, for manual swing operation. Basis-of-design: Arcadia MS362-HD (Heavy Wall) Series.
1. Door Construction: 1-3/4-inch overall thickness, with extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.

2. Door Design: Heavy-duty medium stile for excessive and abusive traffic.
   a. 10' tall smooth finish door bottom. 3-1/2 inch vertical stile.
   b. Provide with intermediate 4” high horizontal rail centered on panic device.
   c. Major portions of the door stiles a nominal 3/16 inches thick, and glass stops .050 inches thick.


4. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 “Door Hardware.”
   1. Opening-Force Requirements:
      a. Egress Doors: Not more than 5 lbf to fully open door.
      b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

B. Weather Stripping: Manufacturer’s standard replaceable components.
   1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
   2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.7 GLAZING

A. Glazing and Glazing Sealants: Comply with Section 08 80 00 “Glazing.”

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, non-bleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Do not use exposed fasteners, except for hardware application. For hardware application, use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.
2.9   FABRICATION

   A. Form or extrude aluminum shapes before finishing.

   B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

   C. Fabricate components that, when assembled, have the following characteristics:
      1. Profiles that are sharp, straight, and free of defects or deformations.
      2. Accurately fitted joints with ends coped or mitered.
      3. Physical and thermal isolation of glazing from framing members.
      4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
      5. Provisions for field replacement of glazing from interior.
      6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

   D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

   E. Storefront Framing: Provide subframes and reinforcing of types indicated or, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

   F. Entrance Door Frames: Fabricate door framing in profiles indicated. Reinforce as required to support loads imposed by door operation and for installing entrance door hardware. Cut, drill, and tap for factory-installed hardware before finishing components.
      1. At exterior doors, provide compression weather stripping at fixed stops.
      2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

   G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
      1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
      2. At exterior doors, provide weather sweeps applied to door bottoms.

   H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

   I. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA’s “Glazing Manual”.

   J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10   ALUMINUM FINISHES

   A. General: Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations relative to applying and designating finishes.

   B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 08 80 00 "Glazing."

G. Install components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
   2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
      c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
      d. Diagonal Measurements: Limit difference between diagonal measurements to 1/8-inch.
   4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 ADJUSTING AND CLEANING

A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

B. Replace or repair components that have damage (to finish or to component) at time of substantial completion.

3.6 MAINTENANCE SERVICE

A. Entrance Door Hardware:
   1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for the Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tubular daylighting devices (skylights) and accessories.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 06 10 00 – “Rough Carpentry” for site-built wood curbs and nailers.

C. Section 07 54 19 – “PVC Single-Ply Roofing” for flashing of skylight base.

D. Section 07 6200 – “Sheet Metal Flashing and Trim” for metal curb flashings.

E. Division 23 – HVAC Air Distribution: Fan vent duct and connections.

F. Division 26 – Electrical: Power cable, power supply and electrical connections.

1.3 REFERENCES


G. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

H. ASTM E 308 - Standard Practice for Computing the Colors of Objects by Using the CIE System.


J. ASTM E 547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain walls by Cyclic Air Pressure Difference.

K. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position.

M. ASTM D 2843 – Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.


O. FM Standard 4431 - The Approval Standard for Skylights


Q. IBC Section 1710 - Load Test Procedure for Wind Load Testing on Rooftop Daylight Collecting System - Structural Performance Testing - Devised by ATI PE); 2012

R. IBC Section 2606.7.2 – Installation – Diffuser Fall Out Test (Devised by PE); 2012

S. OSHA 29 CFR - 1910.23 (e)(8) (Guarding Requirements for Skylights); 1926 Subpart M (Fall Protection); 1926.501(b)(4)(i); 1926.501(i)(2); 1926.501(b)(4)(ii)

T. California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1)

1.4 PERFORMANCE REQUIREMENTS

A. Daylight Reflective Tubes: Spectralight Infinity with Cool Tube Technology combines ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance. Patented spectrally-selective optical surface yields an average total- and specular-reflectance greater than 99.5% percent for the Visible Light spectrum (400 nm to 700 nm) providing maximized visible light transmission and less than 25% reflectance for Infrared (IR) heat wavelengths (750 nm to 2500 nm) for minimized heat transmission, resulting in a spectrally-selective Total Solar Spectrum (250 nm to 2500 nm) reflectance less than 37 percent, as measured using a Perkin Elmer Lambda 1050 spectrophotometer with a Universal Reflectance Accessory. Color: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.

B. SOLAMASTER 750 DS-C (CLOSED CEILING)
   1. AAMA/WDMA/CSA 101/IS2/A440, Class CW-PG70, size tested 21 inch (533 mm) diameter, Type TDDOC and Type TDDCC.
      a. Air Infiltration Test:
         1) Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
      b. Water Resistance Test:
         1) Passes water resistance; no uncontrolled water leakage with a pressure differential of 10.7 psi (512 Pa) or 15 percent of the design load (whichever is greater) and a water spray rate of 5 gallons/hour/sf for 24 minutes when tested in accordance with ASTM E 547 and ASTM E 331.
      c. Uniform Load Test: All units tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.
         1) No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf (7.18 kPa) or Negative Load of 70 psf (3.35 kPa).
   2. Fire Testing:
      a. Fire Rated Roof Assemblies:
         1) When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code for Class A, B, and C roof assemblies.
      b. When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code.
3. Fall Protection Performance:
   a. Passes fall protection test: California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1) Skylight Screens.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Data sheets showing roof dome assembly, flashing base, reflective tubes, diffuser assembly, and accessories.
   4. Installation requirements.

C. Drawings. Submit standard drawings showing layout, profiles and product components, including rough opening and framing dimensions, anchorage, roof flashings and accessories.

D. Electrical wiring diagrams and recommendations for power and control wiring.

E. Verification Samples: Ceiling diffuser lens sample and aluminum finish sample, for each type of exposed finish and reflector required.

F. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

G. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engaged in manufacture of tubular daylighting devices for minimum 15 years.

B. Preinstallation Conference: Conduct conference at Project site

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.
B. Store products in manufacturer's unopened packaging until ready for installation.

1.8 PROJECT CONDITIONS
A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY
A. Daylighting Device: Manufacturer's standard warranty for 10 years.
B. Electrical Parts: Manufacturer's standard warranty for 5 years, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS
B. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00.
D. General Contractor will bear responsibility for costs associated with substitution review.
E. Requests for substitutions will be considered provided a lighting layout with photometric data is supplied to demonstrate light levels will meet original design intent.

2.2 TUBULAR DAYLIGHTING DEVICES
A. Tubular Daylighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.
B. SolaMaster Series: Solatube Model 750 DS, 21 inch (530 mm) Daylighting System:
   1. Model: Solatube Model 750 DS-C Closed (Penetrating) Ceiling. AAMA Type TDDCC.
   2. Capture Zone:
      a. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
         1) Dome Glazing: Type DA, 0.125 inch (3.2 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.
            (a) Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
      b. Tube Ring: 0.090 inch (2.3 mm) nominal thickness injection molded high impact PVC. Prevents thermal bridging between base flashing and tubing and channel condensed moisture. Attached to base of dome ring with butyl glazing rope 0.24 inch (6 mm) diameter; to minimize air infiltration.
      c. Dome Seal: Adhesive backed weatherstrip, 0.63 inch (16 mm) tall by 0.28 inch (7 mm) wide.
   3. Flashings:
      a. Roof Flashing Base:
1) One Piece: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A 653/A 653M or ASTM A 463/A 463M or ASTM A792/A 792M, 0.028 inch (0.7 mm) plus or minus .006 inch (.015 mm) thick.
   (a) Base Style: Type FC, Curb cap, with inside dimensions of 27 inches by 27 inches (685 mm by 685 mm) to cover curb as specified in Section 07600.

b. Flashing Options:
1) Curb Cap Insulation: Type CCI, Nominal 1 inch thick thermal insulation pad to reduce thermal conduction between curb-cap and tubing and thermal convection between room air and curb-cap. Rated R-6 \((^{0}{F}x{ft}^2{x}hr/{Btu})\) Insulation is Polyisocyanurate foam utilizing CFC, HCFC, & HFC free blowing agent. Type-1 Class-1 per ASTM C 1289; Passes UL 1715 (15-minute thermal barrier per IBC 2603.4).

4. Transfer Zone:
a. Extension Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm) conforming to ASTM B 209.
   1) Reflective Tubes:
      (a) Reflective extension tube, Type EXX and Type EL with total length of run as indicated on the Drawings.
      (b) Interior Finish: Spectralight Infinity with Cool Tube Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
   2) Tube Options
      (a) Top Tube Angle Adapter and Bottom Tube Angle Adapter Kit: Type AK, Reflective 45 degree adjustable top and bottom angle adapters (one each), 16 inches (406 mm) long
      (b) Spectralight Infinity SoftLight Extension Tube: Type ES, 24 inch (610 mm) Super-reflective extension tube with structured surface providing precise light spread for enhanced visual comfort. Replaces one standard 24 inch (610 mm) extension tube in the tube assembly.

5. Delivery Zone:
a. Diffuser Assemblies for Tubes Penetrating Ceilings: Solatube Model 750 DS-C. Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; 23.8 inches by 23.8 inches (605 mm by 605 mm) square frame to fit standard suspended ceiling grids or hard ceilings.
   1) Metal Transition Box: Type TM, Metal Round to Square transition box comprised of Spectralight Infinity SoftLight material with structured finish on exposed reflective surface,.015 in (0.4 mm) thick. Color: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
   2) Lens: Type L1, OptiView Fresnel lens design to maximize light output and diffusion with extruded aluminum frame and EPDM foam seal to minimize condensation and bug, dirt and air infiltration per ASTM E 283. Visible Light Transmission shall be greater than 90 percent at 0.022 inch (0.6 mm) thick. Classified as CC2.
   3) Supplemental Natural Effect Lens Type LN, Lens made of acrylic, classified as CC2, Class C, 0.060 inch (1.5 mm) thick, with open cell foam seal to minimize condensation and bug, dirt and air infiltration per ASTM E 283.

b. Delivery Zone Options:
1) Local Dimmer Control utilizing a butterfly baffle design of Spectralight Infinity reflective material to minimize shadowing when in use: Provided with dimmer switch and cable.
   (a) Daylight Dimmer: Type D, Electro-mechanically actuated daylight valve; for universal input voltages ranging between 90 and 277 V
at 50 or 60 Hz; maximum current draw of 50 ma per unit; controlled by low voltage, series Type T02. Provided with dimmer switch and cable. Cable circuited, 4 conductor, size 22 AWG when total aggregate circuit runs are under 200 feet (60.96 m) or size 18 AWG when total aggregate circuit runs are under 500 feet (152.4 m); providing daylight output between 2 and 100 percent.

6. Accessories
   a. Switch: Type SW, Manufacturer-specific low voltage DC DP/DT switch (white) required to operate Daylight Dimmer. Note: only one switch is required per set of synchronously controlled dimmers. For use with Daylight Dimmer, Type D, only. Pre-wired with 30 feet (9.14 m) of 22 AWG, 4 conductor, low-voltage cable.
   b. Cable: Type CA, Optional Two conductor, size 22 AWG, low voltage cable (500 foot) for multiple unit DC connection. For use with Daylight Dimmer, Type D, only, and when aggregate circuit runs do not exceed 200 feet (60.96 m).

2.3 ACCESSORIES
   A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
   B. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

2.4 OTHER MATERIALS
   A. Provide other materials and components, not specifically described but as required for a complete and proper installation, as selected by the Contractor subject to approval of the Architect.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Do not begin installation until substrates have been properly prepared.
   B. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions.
   C. If substrate and rough opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION
   A. Clean surfaces thoroughly prior to installation.
   B. Coordinate requirements for power supply, conduit and wiring.
   C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION
   A. Install in accordance with manufacturer’s printed instructions and reviewed submittals.
   B. Installer shall be factory trained and certified by the manufacturer prior to commencement of installation.
C. Coordinate installation with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing to ensure that each element of the Work performs properly and that finished installation is weather tight.
   1. Install flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
   2. Provide thermal isolation when components penetrate or disrupt building insulation.
      Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
   3. Coordinate attachment and seal of perimeter air and vapor barrier material.
   4. Coordinate electrical work with Division 26 provisions.

D. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, provide permanent separation as recommended by manufacturer

E. Align device free of warp or twist, maintain dimensional tolerances.

F. Inspect installation to verify secure and proper mounting. Test each fixture to verify operation, control functions, and performance, with manufacturer’s technical representative in attendance. Correct deficiencies.

3.4 CLEANING

A. Clean exposed surfaces according to manufacturer’s written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware, including electric hardware.
2. Storefront and entrance door hardware.
3. Gate Hardware.
4. Third-party inspection report for fire-rated door assemblies.
5. Allowance for Best brand cores and keys (Section 01 21 00).
6. Battery-powered electronic credential access control locks and panic hardware lever trim.
7. Impact system frame/door/hardware assembly.
9. Hold-open closers with fire-alarm interface.
10. Wall or floor-mounted electromagnetic hold-open devices.
11. Power supplies for electric hardware.
12. Low energy door operators plus sensors and actuators.
13. Remote button release hardware.
14. Door position switches.
15. Cabinet locks.
17. Cylinders for doors fabricated with locking hardware.
18. Point-to-point wiring diagrams for electric hardware.
19. Key cabinets.

B. Related Divisions:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Division 07 – sealant at exterior thresholds
3. Division 08 – metal doors and frames, interior aluminum frames, wood doors, integrated security systems, specialty doors, storefront systems.
4. Division 10 – operable partitions
5. Division 13 – Integrated Interior Assemblies
6. Division 21 – fire and life safety systems
7. Division 28 – security access systems

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

1. Windows.
2. Cabinets, including open wall shelving and locks.
3. Signs, except where scheduled.
4. Toilet accessories, including grab bars.
5. Rough hardware.
6. Conduit, junction boxes & wiring.
7. Folding partitions, except cylinders where detailed.
11. Welded steel gates and supports.

1.2 REFERENCES

A. Use date of standard in effect as of Bid date.

1. American National Standards Institute
1.3 SUBMITTALS & SUBSTITUTIONS

A. Substitutions per Division 01 requirements. Also, refer to District Board approved Sole Source Items list in Section 016000 Product Requirements for items which may not be substituted. Include product data and indicate benefit to the Project. Furnish operating samples on request.

B. Submit schedule as an electronic copy. Only electronic submittals will be accepted and reviewed. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Minimum 10pt. font size. Include following information:

1. Type, style, function, size, quantity and finish of hardware items.
2. Use BHMA Finish codes per ANSI A156.18.
3. Name, part number and manufacturer of each item.
4. Fastenings and other pertinent information.
5. Location of hardware set coordinated with floor plans and door schedule.
6. Explanation of abbreviations, symbols, and codes contained in schedule.
7. Mounting locations for hardware.
8. Door and frame sizes, materials and degrees of swing.
9. List of manufacturers used and their nearest representative with address and phone number.
10. Catalog cuts.
11. Point-to-point wiring diagrams.
12. Manufacturer’s technical data and installation instructions for electronic hardware.

C. Bid and submit manufacturer’s updated/improved item if scheduled item is discontinued.
D. Deviations: Highlight, encircle or otherwise identify deviations from “Schedule of Finish Hardware” on submittal with notations clearly designating those portions as deviating from this section.

E. If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.

F. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers’ installation, adjustment and maintenance information, and supplier’s final inspection report.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Hardware supplier: direct factory contract supplier who employs a certified Architectural Hardware Consultant (AHC), available at reasonable times during course of work for project hardware consultation to Owner, Architect, construction Manager and Contractor.
   a) Responsible for detailing, scheduling and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.

B. Hardware: Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.

C. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

D. Fire-Rated Openings: NFPA 80 compliant. Hardware UL10C (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, and resilient seals. Coordinate with wood door section for required intumescent seals. Furnish openings complete.

E. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers’ instructions and code requirements.

F. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Include manufacturers’ representatives of locks, panic hardware and door closers in the meetings. Convene prior to commencement of related work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery: coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores: secured delivery direct to Construction Manager.

B. Acceptance at Site: Items individually packaged in manufacturers’ original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

C. Storage: Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS AND COORDINATION

A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect’s approval.
B. Coordination: Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information:

1. Location of embedded and attached items to concrete.
2. Location of wall-mounted hardware, including wall stops.
3. Location of finish floor materials and floor-mounted hardware.
4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation, wood, or foam, on the back of the hollow metal frame behind the rabbet section for continuous hinges, as well as at rim panic hardware strike locations, silencers, coordinators, and door closer arm locations. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer’s bits.
5. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.
6. Coordinate: low-voltage power supply locations.
7. Coordinate: back-up power for doors with automatic operators.
8. Coordinate: flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
9. Manufacturers’ templates to door and frame fabricators.

C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

D. Environmental considerations: segregate unused recyclable paper and paper product packaging, uninstalled metals, and plastics, and have these sent to a recycling center.

1.7 WARRANTY

A. Part of respective manufacturers’ regular terms of sale. Provide manufacturers’ written warranties.

B. Include factory order numbers with close-out documents to validate warranty information, required for Owner in making future warranty claims:

C. Minimum warranties:

1. Locksets: Three years
2. Extra Heavy Duty Cylindrical Lock: Seven Years
3. Exit Devices: Three years mechanical
   One year electrical
4. Closers: Thirty years mechanical
   Two years electrical
5. Hinges: One year
6. Other Hardware Two years

1.8 COMMISSIONING

A. Conduct these tests prior to request for certificate of substantial completion:

1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
2. With installer, access control contractor and electrical contractor present, test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.
3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.
4. Maintenance Materials: Provide the following as per Sections 01 77 00 and 01 78 23:
   A. As-built hardware schedule
   B. Copies of warranty information for each hardware type
   C. Include factory order numbers, needed by Owner if claim needs to be made.
   D. Binder of catalog cuts or complete catalog sections of items used, installation and maintenance/adjustment information.
   E. Collection of tools that were included with the hardware: wrenches, drivers, etc.

1.9 REGULATORY REQUIREMENTS

A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per 2016 California Building Code, Section 11B-404.2.7.
   1. Panic hardware: locate between 36 inches to 44 inches above the finished floor.

B. Handles, pull, latches, locks, other operable parts:
   1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate. 2016 California Building Code Section 11B-309.4.
   2. Force required to activate the operable parts: 5.0 pounds maximum, per 2016 California Building Code Section 11B-309.4.

C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2016 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
   1. Exception: exterior doors’ pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.

   1. Where powered door serves an occupancy of 150 or more, provide back-up battery power or stand-by generator power, capable of supporting a minimum of 100 cycles.
   2. Actuators, vertical bar type: minimum 2-inches wide, 30-inches high, bottom located minimum 5-inches above floor or ground, top located minimum 35-inches above floor or ground. Displays International Symbol of Accessibility, per 2016 California Building Code Section 11B-703.7.
   3. Actuators, plate type: use two at each side of the opening. Minimum 4-inches diameter or 4-inches square. Displays International Symbol of Accessibility, per 2016 California Building Code Section 11B-703.7. Locate centerline of lower plate between 7- and 8-inches above floor or ground, and upper plate between 30- and 44-inches above floor or ground.
   4. Actuator location: conspicuously located, clear and level floor/ground space for forward or parallel approach.

E. Adjust door closer sweep periods so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the landing side of the door, per 2016 California Building Code Section 11B-404.2.8.
   1. Spring hinges: adjust for 1.5 seconds minimum for 70 degrees to fully-closed.

F. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2016 California Building Code Section 11B-404.2.10.
   1. Applied kickplates and armor plates: bevel the left and right edges; free of sharp or abrasive edges.
2. Tempered glass doors without stiles: bottom rail may be less than 10 inches if top leading edge is tapered 60 degrees minimum.

G. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 30 inches and below 80 inches, and the hardware projects no more than 4 inches. 2016 California Building Code Section 11B-404.2.3.
   1. Exception: In alterations, a projection of 5/8 inch (15.9 mm) maximum into the required clear width shall be permitted for the latch side stop.
   2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2016 California Building Code 11B-307.4.

H. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2016 California Building Code Section 11B-404.2.5. Vertical rise no more than 0.25 inches, change in level between 0.25 inches and 0.50 inches: beveled to slope no greater than 1:2 (50 percent slope). 2016 California Building Code Section 11B-303.2 & ~.3.

I. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).

J. Pairs of doors with independently-activated hardware both leafs: limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per 2016 California Building Code Section 11B-703.4.2.

K. Door and door hardware encroachment: when door is swung fully-open into means-of-egress path, the door may not encroach/project more than 7 inches into the required exit width, with the exception of door release hardware such as lockset levers or panic hardware. These hardware items must be located no less than 34-inches and no more than 48-inches above the floor/ground. 2016 California Building Code, Section 1005.7.1.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers and their abbreviations used in this schedule:

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<thead>
<tr>
<th>Manufacturer</th>
<th>Abbreviation</th>
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<td>Adams Rite</td>
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<td>VON</td>
</tr>
<tr>
<td>Yale</td>
<td>YAL</td>
</tr>
<tr>
<td>Zero International</td>
<td>ZER</td>
</tr>
</tbody>
</table>

2.2 HINGING METHODS

A. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.

B. Conform to manufacturer’s published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer’s standard exceeds the scheduled product, furnish the heavier of the two choices; notify architect of deviation from scheduled hardware.

C. Conventional Hinges: Steel or stainless steel pins and approved bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.

1. Outswinging exterior doors: non-ferrous with non-removable (NRP) pins and security studs.
2. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.

D. Continuous Hinges:
1. Geared-type aluminum.
   a) Use wide-throw units where needed for maximum degree of swing, advise architect if commonly available hinges are insufficient.
   b) If units are used at storefront openings, color-coordinate hinge finish with storefront color. Custom anodizing and custom powdercoat finishes subject to Architect approval.

2. Pinned steel/stainless steel type: continuous stainless steel, 0.25-inch diameter stainless-steel hinge pin.
   a) Use engineered application-specific wide-throw units as needed to provide maximum swing degree of swing; advise architect if required width exceeds 8 inches.

E. Pivots: high-strength forged bronze or stainless steel, tilt-on precision bearing and bearing pin.
   1. Bottom and intermediate pivots: adjustability of minus 0.063 inch, plus 0.125 inch.

F. Floor Closers: hydraulically controlled, cement case, maximum degree dead stop permitted by trim or adjacent structure. Special pins, floor pans and longer spindles when needed to accommodate floor and jamb conditions.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

A. Mortise Locksets and Latchsets: as scheduled.

1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
2. Universal lock case – 10 functions in one case.
3. Floating mounting tabs automatically adjusts to fit a beveled door edge.
4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
5. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
   a) Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever’s hubworks to gain wrongful entry.
   b) Inside lever applied by screwless shank mounting – no exposed trim mount screws.
   c) Levers rotate up or down for ease of use.
   d) Vandalgard locks: locked lever freely rotates down while remaining securely locked. This feature prevents damage to internal lock components when subjected to excessive force.

6. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
7. Turnpieces: accessible offset turn-lever design not requiring pinching or twisting motions to operate.
10. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
12. Certifications:
   a) ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.
   b) ANSI/ASTM F476-84 Grade 31 UL Listed.
13. Accessibility: Require not more than 5 lb to retract the latchbolt or deadbolt, or both, per CBC 2016 11B-404.2.7 and 11B-309.4.

B. Extra Heavy Duty Cylindrical Locks and Latches: as scheduled.
1. **Chassis**: cylindrical design, corrosion-resistant plated cold-rolled steel, through-bolted.
2. **Locking Spindle**: stainless steel, integrated spring and spindle design.
4. **Latchbolt**: solid steel.
5. **Backset**: 2.75 inches typically, more or less as needed to accommodate frame, door or other hardware.
6. **Lever Trim**: accessible design, independent operation, spring-cage supported, minimum 2.00 inches clearance from lever mid-point to door face.
7. **Electric operation**: Manufacturer-installed continuous duty solenoid.
8. ** Strikes**: 16 gage curved steel, bronze or brass with 1.00 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
10. **Certifications**: a) ANSI A156.2, 1994, Series 4000, Grade 1. b) UL listed for A label and lesser class single doors up to 4 feet x 8 feet.
11. **Accessibility**: Require not more than 5 lb to retract the latchbolt or deadlock, or both, per CBC 2016 11B-404.2.7 and 11B-309.4

C. **Standard Duty Cylindrical Locks and Latches**: as scheduled.

1. **Chassis**: cylindrical design, corrosion-resistant plated cold-rolled steel, through-bolted.
2. **Locking Spindle**: stainless steel, interlocking design.
3. **Latch Retractors**: forged steel. Balance of inner parts: corrosion-resistant plated steel or stainless steel.
4. **Backset**: 2.75 inches typically, more or less as needed to accommodate frame, door or other hardware.
5. **Lever Trim**: accessible design, independent operation, spring-cage supported, minimum 2.00 inches clearance from lever mid-point to face of door.
7. **Certifications**: a) ANSI A156.2, 1994, Series 4000, Grade 2. b) UL listed for A label and lesser class single doors up to 4 feet x 8 feet.
8. **Accessibility**: Require not more than 5 lb to retract the latchbolt or deadlock, or both, per CBC 2016 11B-404.2.7 and 11B-309.4

2.4 **EXIT DEVICES / PANIC HARDWARE**

A. **General features:**

1. Independent lab-tested 1,000,000 cycles.
3. Deadlocking latchbolts, 0.75 inch projection.
4. **End caps**: impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.
5. No exposed screws to show through glass doors.
6. **Non-handed basic device design with center case interchangeable with all functions**, no extra parts required to effect change of function.
7. Releasable in normal operation with 15-pound maximum operating force per UBC Standard 10-4, and with 32-pound maximum pressure under 250-pound load to the door.
9. **Accessibility**: Require not more than 5 lb to retract the latchbolt, per CBC 2016 11B-404.2.7 and 11B-309.4.
a) Mechanical method: Von Duprin “AX-” feature, where touchpad directly retracts the latchbolt with 5 lb or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb requirement.

b) Electrical method: Von Duprin’s “RX-QEL-”, where lightly pressing the touchpad with 5 lb or less of force closes an electric switch, activating quiet electric latch retraction.

B. Specific features:

2. Lever Trim: breakaway type, forged brass or bronze escutcheon min. 0.130 inch thickness, compression spring drive, match lockset lever design.
3. Rod and latch guards with sloped full-width kickplates for doors fitted with surface vertical rod devices with bottom latches.
5. Impact recessed devices: 1.25 inch projection when push-pad is depressed. Sloped metal end caps to deflect carts, etc. No pinch points to catch skin between touchbar and door.
6. Delayed Egress Devices: Function achieved within single exit device component, including latch, delayed locking device, request-to-exit switch, nuisance alarm, remote alarm, key switch, indicator lamp, relay, internal horn, door position input, external inhibit input plus fire alarm input. NFPA 101 “Special Locking Arrangement” compliant.
7. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
8. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key. Furnish storage brackets for securely stowing the mullion away from the door when removed.

2.6 CLOSERS

C. Surface Closers:

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2016 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
   a) Exception: exterior doors’ pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors: seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid, will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted. Note: Norton 7500 includes PRV only with their delayed-action cylinders.

2.7 OTHER HARDWARE

A. Automatic Flush Bolts: Low operating force design.

B. Overhead Stops: Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

C. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

D. Door Stops: Provide stops to protect walls, casework or other hardware.
   1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.


F. Automatic door bottoms: low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.
   1. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and elevator lobbies to allow fine-tuning of pressurization systems.

G. Thresholds: As scheduled and per details. Comply with CBC 2016 11B-404.2.5. Substitute products: certify that the products equal or exceed specified material’s thickness. Proposed substitutions: submit for approval.
   1. Saddle thresholds: 0.125 inches minimum thickness.
   2. Exteriors: Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 “Thermal and Moisture Protection”. Minimum 0.25 inch diameter fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors. Zero International’s #226, National Guard Products’ “COMBO” or Pemko Manufacturing’s “FHSL”.
   3. Fire-rated openings, 90-minutes or less duration: use thresholds to interrupt floor covering material under the door where that material has a critical radiant flux value less than 0.22 watts per square centimeter, per NFPA 253. Use threshold unit as scheduled. If none scheduled, include a 0.25in high 5in wide saddle in the bid, and request direction from Architect.
   4. Fire-rated openings, 3-hour duration: Thresholds, where scheduled, to extend full jamb depth.
   5. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.
   6. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.
   7. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

H. Silencers: Interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Leave no unfilled/uncovered pre-punched silencer holes. Intent: door bears against silencers, seals make minimal contact with minimal compression – only enough to effect a seal.

I. Key Control Software: Same manufacturer as key cylinders, supply to Owner.
2.8 FINISH:
A. Generally: BHMA 626 Satin Chromium.
   1. Areas using BHMA 626: furnish push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise scheduled.
B. Door closers: factory powder coated to match other hardware, unless otherwise noted.
C. Finish designators used in appended hardware schedule:

<table>
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<th>US</th>
<th>Description</th>
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<td>US32D</td>
<td>Satin Stainless Steel, 300 Series</td>
<td>Stainless Steel</td>
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2.9 KEYING REQUIREMENTS:
A. Key System: existing Best Access Systems small format interchangeable core system, procured per Allowances in 1.1.C. Owner’s Agent will install the cores prior to Substantial Completion. Initiate and conduct meeting(s) with Owner to determine system structure and keybow styles, furnish Owner’s written approval of the system. Do not order keys or cylinders without written confirmation of actual requirements from the Owner. Owner will order and supply permanent cylinders/cores.
B. Interchangeable Cores: 7-pin solid brass construction.
C. Permanent cores: furnish factory-keyed.
D. Procure scheduled brand temporary cylinder cores and operating and control keys from the Manufacturer of the locks. Provide an allowance of $45 per core for Permanent cores, coordinate through Owner’s Agent and Best for purchase of Permanent cores. No Keys will be needed for these Permanent cores. Provide an allowance for a pack of 100 HID Corp 1000 Fobs. Coordinate through the Owner’s Agent and HID for the purchase of the Fobs.

PART 3 - EXECUTION
3.1 ACCEPTABLE INSTALLERS:
A. Can read and understand manufacturers’ templates, suppliers’ hardware schedule and printed installation instructions. Can readily distinguish drywall screws from manufacturers’ furnished fasteners. Available to meet with manufacturers’ representatives and related trades to discuss installation of hardware.

3.2 PREPARATION:
A. Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation. Installation denotes acceptance of wall/frame condition.
A. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.
   1. Notify Architect of code conflicts before ordering material.
   2. Locate latching hardware between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1008.1.9.2 and 1133B.2.5.2.
3. Locate panic hardware between 36 inches to 44 inches above the finished floor.
4. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

B. Overhead stops: before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

3.3 INSTALLATION
A. Install hardware per manufacturer's instructions and recommendations and approved submittals. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.

1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
3. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
4. Replace fasteners damaged by power-driven tools.

B. Locate floor stops no more than 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths. Door shall be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.

C. Core concrete for exterior door stop anchors. Set anchors in approved non-shrink grout.

D. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.

E. Drill pilot holes for fasteners in wood doors and/or frames.

F. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4. ADJUSTING
A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.

1. Hardware damaged by improper installation or adjustment methods: repair or replace to Owner’s satisfaction.
2. Adjust doors to fully latch with no more than 1 pound of pressure.
   a) Door closer valves: turn valves clockwise until at bottom – do not force. Turn valves back out one and one-half turns and begin adjustment process from that point. Do not force valves beyond three full turns counterclockwise.
3. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
4. Adjust door closers per paragraph 1.9 this section.
B. Inspection of fire door assemblies and means-of-egress panic-hardware doors: Per 2016 NFPA-80 5.2.1: hire an independent third-party inspection service to prepare a report listing these doors, and include a statement that there are zero deficiencies with the fire-rated assemblies and the openings with panic hardware. Certification, Testing and Quality Control shall be in accordance with Section 01 40 00 Quality Requirements. All doors hardware and installation will be inspected by a third party selected by the Architect and owner.

Div 01 45 23:

1. Per 2016 NFPA-80 5.2.1: Use a third party inspector not associated with the construction, supply or installation of this project to develop a field survey of the doors and hardware. Survey is to be done by a member certified as a FDAI (Fire Door Assembly Inspector), Certified AHC (Architectural Hardware Consultant) or a certified testing laboratory: UL or Intertek. Certified Inspectors may be found at DHI.org, Intertek, or CAFDI.org.

C. Fire-rated doors:

1. Wood doors: adjust to 0.125 inches clearance at heads, jambs, and meeting stiles.
2. Steel doors: adjust to 0.063 inches minimum to 0.188 inches maximum clearance at heads, jambs, and meeting stiles.
3. Adjust wood and steel doors to 0.75 inches maximum clearance (undercut) above threshold or finish floor material under door.

D. Final inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following:

1. Has re-adjusted hardware.
2. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
3. Has identified items that have deteriorated or failed.

3.5 DEMONSTRATION:

A. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

3.6 PROTECTION/CLEANING:

A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.

B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

3.7 SCHEDULE OF FINISH HARDWARE

A. See door schedule in Drawings for hardware set assignments.

B. Do not order material until submittal has been reviewed, stamped, and signed by Architect’s door hardware consultant and Architect as “approved”.
HARDWARE GROUP NO. 01 -
PERIMETER SEALS BY DOOR MANUFACTURER
KEY SWITCH TO BE USED TO TURN AUTO OPERATOR ON/OFF

For use on Door #(s):
346A
Provide each PR door(s) with the following:

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<th>DESCRIPTION</th>
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POWER SUPPLY BY OTHERS
ACCESS CONTROL BY OTHERS

KEY SWITCH TO TURN ON/OFF OPERATOR. PANIC HARDWARE TO BE DOGGED DOWN PRIOR TO TURNING OPERATOR ON.
ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.
HARDWARE GROUP NO. 02
For use on Door #s:
346B
Provide each PR door(s) with the following:

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ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

HARDWARE GROUP NO. 03 - PERIMETER SEALS BY DOOR FRAME MANUFACTURER

For use on Door #s:
302B 316
Provide each SGL door(s) with the following:

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<td>652</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
<td>5BB1 4.5 X 4.5 CON TW4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EU MORTISE LOCK</td>
<td>L9092BDCEO M81A RX CON 12/24 VDC</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CORE</td>
<td>1C71</td>
<td>626</td>
<td>BES</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>626</td>
<td>IVE</td>
<td></td>
</tr>
</tbody>
</table>

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.
HARDWARE GROUP NO. 03A - PERIMETER SEALS BY DOOR/FRAME MANUFACTURER

For use on Door #312:

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
<td>5BB1 4.5 X 4.5 CON TW4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EU MORTISE LOCK</td>
<td>L9092BDCEU M81A RX CON</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
</tbody>
</table>

12/24 VDC

1   | CORE                | 1C71            | 626    | BES    |     |

(UNCOMBINED)

1   | SURFACE CLOSER      | 4040XP          | 689    | LCN    |     |

1   | FLOOR STOP          | FS438           | 626    | IVE    |     |

ACCESS CONTROL BY OTHERS

POWER SUPPLY BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

HARDWARE GROUP NO. 03B

For use on Door #306

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
<td>5BB1 4.5 X 4.5 CON TW4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EU MORTISE LOCK</td>
<td>L9092BDCEU M81A RX CON</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
</tbody>
</table>

12/24 VDC

1   | CORE                | 1C71            | 626    | BES    |     |

(UNCOMBINED)

1   | SURFACE CLOSER      | 4040XP          | 689    | LCN    |     |

1   | KICK PLATE          | 8400 10" X 2" LDW B-CS | 630    | IVE    |     |

1   | WALL STOP           | WS406/407CCV    | 626    | IVE    |     |

1   | GASKETING           | 270A            | A      | ZER    |     |

3   | SILENCER            | SR64            | GRY    | IVE    |     |

ACCESS CONTROL BY OTHERS

POWER SUPPLY BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.
HARDWARE GROUP NO. 03D
For use on Door #(s):
308 309 310 311 327 332
Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
<td>5BB1 4.5 X 4.5 CON TW4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EU MORTISE LOCK</td>
<td>L9092BDCEU M81A RX CON 12/24 VDC</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CORE (UNCOMBINATED)</td>
<td>1C71</td>
<td>626</td>
<td>BES</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS438</td>
<td>626</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
<td></td>
</tr>
</tbody>
</table>

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

HARDWARE GROUP NO. 03E
For use on Door #(s):
324
Provide each SGL door(s) with the following:

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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
<td>5BB1 4.5 X 4.5 CON TW4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CORE (UNCOMBINATED)</td>
<td>1C71</td>
<td>626</td>
<td>BES</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EU MORTISE LOCK</td>
<td>L9092BDCEU M81A RX CON 12/24 VDC</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP CUSH</td>
<td>689</td>
<td>LCN</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
<td></td>
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</tbody>
</table>

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

HARDWARE GROUP NO. 06 - HARDWARE BY DIRTT SYS
For use on Door #(s):
301A 301B 302A 303 304 317
318 319 320 321 322 323
326A 328 329A 330 331A 342A
342B 343A 345
### HARDWARE GROUP NO. 11
For use on Door #(s):
313
Provide each SGL door(s) with the following:

<table>
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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
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</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S BRK</td>
<td>626</td>
<td>SCH</td>
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</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS438</td>
<td>626</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SILENCER</td>
<td>SR65</td>
<td></td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. 18
For use on Door #(s):
329B 331B
Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
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<tbody>
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<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
<td>5BB1 4.5 X 4.5 CON TW4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EU MORTISE LOCK</td>
<td>L9092BDCEU M81A RX CON 12/24 VDC</td>
<td>626</td>
<td>SCH</td>
<td></td>
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<tr>
<td>1</td>
<td>CORE</td>
<td>1C71</td>
<td>626</td>
<td>BES</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE Closer</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS438</td>
<td>626</td>
<td>IVE</td>
<td></td>
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<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>626</td>
<td>AA ZER</td>
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</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA-S</td>
<td>626</td>
<td>AA ZER</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td></td>
<td>A ZER</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A-223</td>
<td>4</td>
<td>A ZER</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR65</td>
<td></td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

ACCESS CONTROL BY OTHERS
POWER SUPPLY BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

### HARDWARE GROUP NO. 19
For use on Door #(s):
333 334
Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
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<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
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</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>L9080BD 17A</td>
<td>626</td>
<td>SCH</td>
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</tr>
<tr>
<td>1</td>
<td>ELECTRIC STRIKE</td>
<td>6211 FSE DS CON</td>
<td>630</td>
<td>VON</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURF. AUTO OPERATOR</td>
<td>9542 HL/D MS ANCLR LCN</td>
<td>630</td>
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<tr>
<td>2</td>
<td>ACTUATOR</td>
<td>8310-836T</td>
<td>630</td>
<td>LCN</td>
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<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCCV</td>
<td>626</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td></td>
<td>GRY</td>
<td>IVE</td>
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</table>

POWER SUPPLY BY OTHERS
ACCESS CONTROL BY OTHERS
HARDWARE GROUP NO. 20 –
PERIMETER SEALS BY DOOR/FRAME MANUFACTURER
For use on Door #(#): 335A
Provide each PR door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
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<tr>
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<td>112HD EPT</td>
<td>313AN</td>
<td>IVE</td>
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<tr>
<td>2</td>
<td>EA POWER TRANSFER</td>
<td>EPT10</td>
<td>#</td>
<td>695</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EA CORE (UNCOMBINATED)</td>
<td>1C71</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA ELEC PANIC</td>
<td>RX-QEL-PA-9947-NL-OP-HARDWARE</td>
<td># 626</td>
<td>VON</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA ELEC PANIC</td>
<td>RX-QEL-PA-9947-EO-LBR-HARDWARE</td>
<td># 626</td>
<td>VON</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EA 90 DEG OFFSET PULL</td>
<td>8190HD 10&quot; O</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EA SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EA FLOOR STOP</td>
<td>FS438</td>
<td>626</td>
<td>LCN</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA POWER SUPPLY</td>
<td>PS902 BBK 900-2RS</td>
<td># PROVIDED</td>
<td>LGR</td>
<td>SCE</td>
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ACCESS CONTROL BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

HARDWARE GROUP NO. 21
For use on Door #(#): 335B
Provide each SGL door(s) with the following:

<table>
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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
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<th>ITEMID</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
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<td>3</td>
<td>EA HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
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</tr>
<tr>
<td>1</td>
<td>EA CORE (UNCOMBINATED)</td>
<td>1C71</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA PANIC HARDWARE</td>
<td>LD-PA-AX-98-L-M81</td>
<td>626</td>
<td>VON</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC MORTISE CYL.</td>
<td>80-101 114</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA ELECTRIC STRIKE</td>
<td>6111 FSE</td>
<td>630</td>
<td>VON</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
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<tr>
<td>1</td>
<td>EA FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
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<tr>
<td>1</td>
<td>EA GASKETING</td>
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<td>AA</td>
<td>ZER</td>
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<tr>
<td>1</td>
<td>EA DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA THRESHOLD</td>
<td>655A-223</td>
<td>A</td>
<td>ZER</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>EA SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
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</table>

ACCESS CONTROL BY OTHERS

POWER SUPPLY BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.
HARDWARE GROUP NO. 22 - ALL HARDWARE BY DOOR MANUFACTURER
For use on Door # (s):
335C

HARDWARE GROUP NO. 23
For use on Door # (s):
336
339
Provide each PR door(s) with the following:

<table>
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<td>IVE</td>
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<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
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<td>652</td>
<td>IVE</td>
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<tr>
<td>1</td>
<td>MANUAL FLUSH BOLT</td>
<td>FB458 12&quot;</td>
<td>626</td>
<td>IVE</td>
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<tr>
<td>1</td>
<td>MANUAL FLUSH BOLT</td>
<td>FB458 24&quot;</td>
<td>626</td>
<td>IVE</td>
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</tr>
<tr>
<td>1</td>
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<tr>
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<tr>
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POWER SUPPLY BY OTHERS
ACCESS CONTROL BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.
HARDWARE GROUP NO. 24
For use on Door #337:
Provide each SGL door(s) with the following:

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POWER SUPPLY BY OTHERS
ACCESS CONTROL BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

HARDWARE GROUP NO. 25
For use on Door #338:
Provide each SGL door(s) with the following:

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<tr>
<td>1</td>
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<tr>
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<tr>
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ACCESS CONTROL BY OTHERS
POWER SUPPLY BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.
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</tr>
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**POWER SUPPLY BY OTHERS**

**ACCESS CONTROL BY OTHERS**

**ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.**

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**POWER SUPPLY BY OTHERS**

**ACCESS CONTROL BY OTHERS**

**ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.**

**MAGNETIC HOLD OPEN IS PROVIDED FOR SECURITY PURPOSES DOORS TO BE CLOSED BY THE USER. THE MAG HOLDERS ARE NOT TO RELEASE UPON FIRE ALARM ACTIVATION.**
HARDWARE GROUP NO. 28
For use on Door #(s):
326B
Provide each PR door(s) with the following:

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<thead>
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<td>A</td>
<td>ZER</td>
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POWER SUPPLY BY OTHERS
ACCESS CONTROL BY OTHERS

ALL ELECTRIFIED ACCESS CONTROL LOCK HARDWARE, ELECTRIFIED EXIT DEVICES, TRANSFER HINGES, AND MANUFACTURER RECOMMENDED POWER SUPPLIES TO BE SUPPLIED BY SECURITY CONTRACTOR. HARDWARE IS SHOWN FOR TEMPLATING PURPOSES ONLY.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows and Doors
   2. Storefront framing.
   3. Glazed entrances.
   4. Interior lites.

B. Related Sections:
   1. Doors and Windows: Elsewhere in Division 08.

1.2 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Provide glass lites in the thickness and strengths (annealed or heat-treated) to meet or exceed the following criteria based on analysis of Project loads and in-service conditions.
   1. Minimum glass thickness of lites composed of annealed or heat-treated glass are selected so the worst-case probability of failure does not exceed the following:
      a. 8 lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action.
      b. 1 lite per 1000 for lites set over 15 degrees off vertical and under action of wind.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer’s published test data, as determined according to procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
   a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.

E. Glass Supports and Deflection:
   1. Where one or more sides of any pane of glass are not firmly supported, or are subjected to unusual load conditions, detailed construction documents, detailed shop drawings and analysis or test data assuring safe performance for the specific installation shall be prepared by a registered design professional. (CBC 2403.2).
      a. The construction documents and analysis or test data required per CBC Section 2403.2 shall be submitted to the enforcement agency for approval.
      b. Glass firmly supported on all four edges shall be glazed with minimum laps and edge clearances set forth in CBC Table 2403.2.1.
   2. Where interior glazing is installed adjacent to a walking surface, the differential deflection of two adjacent unsupported edges (butt glazing) shall not be greater than the thickness of the panels when a force of 50 pounds per linear foot (plf) is applied horizontally to one panel at any point up to 42 inches above the walking surface. (CBC 2403.4). Submit calculations and test data upon request to the enforcement agency having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 6-inch- square samples for glass and of 6-inch-long samples for sealants. Install sealant samples between two strips of material representative in color of the adjoining framing system.
   1. Each Glass Type in Article 3.6.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. Product Test Reports: For each of the following types of glazing products:
   1. Coated float glass.
   2. Insulating glass.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance.

B. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or in referenced standards.
1. **GANA Publications**
   b. Laminating Division – Laminated Glass Design Guide

2. **LSGA Publications**

3. **SIGMA Publications -- TM3000-Recommended Practices for Vertical and Basic Field Glazing of Organically Sealed Insulating Glass Units.**

C. **Source Limitations for Glass:** Obtain glass from a single manufacturer for each glass type. Single Source fabrication responsibility: All fabrication processes, including Low-E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single Fabricator.

D. **Source Limitations for Glazing Accessories:** Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. **Glass Product Testing:** Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
   1. **Glass Testing Agency Qualifications:** An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

F. **Safety Glazing Products:** Comply with testing requirements in 16 CFR 1201, and with ANSI Z97.1.
   1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
   2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

G. **Glazing Publications:** Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. **GANA Publications:** GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
   2. **IGMA Publication for Insulating Glass:** SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

H. **Insulating-Glass Certification Program:** Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency: Insulating Glass Certification Council.

I. **Glass fabricator to have 10 years of experience and meet ANSI / ASQC Q9002 1994.**

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 **PROJECT CONDITIONS**

A. **Environmental Limitations:** Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1.8 WARRANTY

A. Manufacturer’s Special Warranty for Coated-Glass Products: Manufacturer’s standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in “Definitions” Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: 10 years from date of manufacture.

B. Manufacturer’s Special Warranty on Laminated Glass: Manufacturer’s standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in “Definitions” Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: Five years from date of Manufacture.

C. Manufacturer’s Special Warranty on Insulating Glass: Manufacturer’s standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in “Definitions” Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: 10 years from date of Manufacture.

D. Provide a written 5-year warranty from date of manufacture for ceramic frit on any spandrel glass. Warranty covers deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer’s published instructions.

E. Provide a written 5-year warranty from date of manufacture for fully tempered glass that has been Heat Soaked. Warrants that heat soaked tempered glass will not break spontaneously as a result of Nickel Sulfide (NiS) inclusions at a rate exceeding 0.5% (5/1000) for a period of five years from the date of manufacture. A warranty alone for Nickel Sulfide breakage will not be acceptable. All tempered glass must be 100% heat soaked.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Vitro Architectura (formerly PPG glass) has been selected as the basis of design. Any alternates must meet the performance and match the aesthetics of the specified products.

B. Available Manufacturers and Fabricators: Subject to compliance with requirements, possible manufacturers offering products that may be incorporated into the Work include, but are not limited to:
   1. Cardinal Glass Industries
   2. Guardian Industries
   3. Pilkington
   4. Oldcastle
   5. Viracon

2.2 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
   2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and...
to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass (tempered glass) is indicated or required by Codes.

C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
2. Provide Kind FT (fully tempered) glass lites where safety glass (tempered glass) is indicated.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Sealing System: Dual seal, with primary and secondary sealants as follows:
   a. Polyisobutylene and silicone.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
   a. Spacer Material: Confirm aluminum color with Architect prior to order.
   b. Desiccant: Molecular sieve or silica gel, or blend of both.
   c. Corner Construction: Manufacturer's standard corner construction.
6. ASTM E2190/773 Seal Durability of Sealed Insulating Glass Units.
7. ASTM E2190/774 Sealed Insulating Glass Units.
8. Lites shall be separated by an aluminum spacer with 3 bent corners and 1 keyed- soldered corner, or 4 bent corners and a straight butyl injected zinc plated steel straight key joint, to provide a hermetically sealed and dehydrated air space.
9. Units shall be certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) and tested in accordance with the above ASTM Test Methods.

2.3 GLAZING TAPES
A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C1281 and AAMA 800 for products indicated below:
   1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
   1. Type 1, for glazing applications in which tape acts as the primary sealant.
   2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.4 MISCELLANEOUS GLAZING MATERIALS
A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
C. Setting Blocks: 100% silicone durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).


2.5 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep system.
   3. Minimum required face or edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.
3.6 SCHEDULE OF GLASS TYPES

GL-1: Insulating Glazing Unit (Low-E Coated Glass): Use at all exterior glazing
   b. Provide Low-E Coating on number 2 surface as fabricated by manufacturer to comply with specified requirements.
   d. Silicone: Color as selected by Architect to match approved sample.
   e. Interior Glass Ply: 1/4" Clear Heat-strengthened. Temper and 100% heat soak where needed to meet safety glazing code.
   f. Visible Light Transmittance: 64
   g. Solar Heat Gain Coefficient (SHGC): 0.27
   h. Light to Solar Gain (LSG): 2.37

GL-2: Laminated Glass at All Interior Storefront:
   b. 3/8” thick laminated clear, fully-tempered.
   c. Laminate Makeup: 5mm Vitro Starphire, .030PVB clear Interlayer, 5mm Vitro Starphire.
   d. Heat-strengthen all glass.

GL-3: Decorative Front Counter Glass Panel
   a. Basis of Design: Skyline Design (www.skydesign.com) Scatter Pattern, Green/Blue, Option
   c. Apply to 1/4” (6mm) Starphire fully-tempered glass.

GL-4: Front Counter Divider Panel
   a. 1/2” Laminated White Tempered, Monolithic
   b. Laminate Makeup: 6mm clear, .030PVB interlayer with 50% white, 6mm clear.
   c. Match Architect’s sample. Fully-temper all glass.

GL-5: Glazing System Used on Integrated Interior Assemblies (Modular Partitions): See Section 134273.

GL-6: Insulating Glazing Unit: at Interior STC system.
   b. Makeup: 3mm Starphire_.030PVB_3mmStarphire | Air 7/16” (11.1mm) | 3mm Starphire_.030PVB_3mm Starphire. Overall thickness: 1 inch.
   c. Visible light transmittance: 83%
   d. Transmittance, Total Solar: 73%
   e. Shading Coefficient: 0.89
   f. Solar Heat Gain Coefficient (SHGC): 0.77
   g. Thermal Stress Risk: Low.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Drainable fixed extruded aluminum exterior louvers, as indicated on Drawings.

1.2 RELATED SECTIONS
   A. Section 07 62 00 – Sheet Metal Flashing and Trim
   B. Section 07 92 00 - Joint Sealants

1.3 REFERENCES
   B. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
   C. AMCA 511 - Certified Ratings Program for Air Control Devices.
   E. ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings

1.4 DEFINITIONS
   A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

1.5 ACTION SUBMITTALS
   A. Submit under provisions of Section 01 33 00.
   B. Product Data: For each product to be used, including:
      1. Manufacturer’s product data including performance data.
      2. Preparation instructions and recommendations.
      3. Installation methods.
   C. Shop Drawings:
      1. Submit shop drawings indicating materials, thickness, construction, dimensions, accessories, and installation details.
   D. Samples: Provide sample of factory-finish color selected by Architect.
E. Sustainable Design (LEED) Submittals:
   For products intending to count towards LEED Materials & Resources credits for Building
   Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw
   Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health
   Product Declaration), and/or Material Ingredient Optimization certifications, and/or
   Product Manufacturer Supply Chain Optimization certifications: for each product.

1.6 INFORMATIONAL SUBMITTALS
   A. Product Test Reports: For each type of louver, for tests performed by a qualified testing
      agency.
   B. Sample Warranties: For manufacturer's warranties.

1.7 QUALITY ASSURANCE
   A. Manufacturer Qualifications:
      1. The manufacturer shall have implemented the management of quality objectives,
         continual improvement, and monitoring of customer satisfaction to assure that
         customer needs and expectations are met.
      2. Manufacturer shall be International Organization for Standardization (ISO) 9001
         accredited.
   B. Product Qualifications:
      1. Louvers tested to AMCA 500 L Standards. Ratings based on tests and procedures
         performed in accordance with AMCA 511.
      2. Louvers shall be factory engineered to withstand the specified seismic loads.
         a. Minimum design loads shall be calculated to comply with ASCE – 7, or local
            requirements of Authority Having Jurisdiction (AHJ).
      3. Maximum allowable deflection for the louver structural members to be 1/180 or 0.75
         inch, whichever is less. Maximum allowable deflection for the louver blades to be
         1/120 or 0.50 inch across the weak axis, whichever is less.

1.8 DELIVERY, STORAGE, AND HANDLING
   A. Store products in manufacturer's unopened packaging until ready for installation.
   B. Store materials in a dry area indoors, protected from damage and in accordance with
      manufacturer's instructions.
   C. Handling: Protect materials and finishes during handling and installation to prevent damage.
   D. Store and dispose of solvent-based materials, and materials used with solvent-based
      materials, in accordance with requirements of local authorities having jurisdiction.

1.9 PROJECT CONDITIONS
   A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits
      recommended by manufacturer for optimum results. Do not install products under
      environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY
A. Manufacturer shall provide standard limited warranty for louver systems for a period of five years from date of installation, no more than 5 years after shipment from manufacturing plant. When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without cost to the Owner.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS


B. Subject to compliance with specified requirements, alternate manufacturers offering comparable products may include: Airolite, Ruskin, and Greenheck.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00.

2.2 HIGH-PERFORMANCE DRAINABLE FIXED MULLION LOUVER

A. Model: Construction Specialties Model A4177, 4 inch wide.
   1. Material: Heads, sills, jambs and mullions to be one piece structural aluminum members with integral caulking slot and retaining beads. Mullions shall be sliding interlock with internal drains. Blades to be one piece aluminum extrusions with gutters designed to catch and direct water to jamb and mullion drains. Compression gaskets shall be provided between bottom of mullion or jamb and top of sill to insure leak tight connections. Material thickness to be as follows: Heads: 0.070” (1.78mm), Sills: 0.080” (2.03mm), jambs and mullions: 0.125” (3.18mm), fixed blades: 0.070” (1.78mm).

B. AMCA Performance: A 4’ x 4’ unit shall conform to the following and be licensed to bear the AMCA seal:
   1. Free Area: 8.80 Sq. Ft.
   2. Free area velocity at the point of beginning water penetration Intake: 1087 FPM.
   3. Pressure drop at the point of beginning water penetration Exhaust: 0.18 inch, H2O
   4. Pressure drop at the point of beginning water penetration: 0.15 inch, H2O.

2.3 ACCESSORIES

A. Insect Screens:
   1. Aluminum: 18-16 mesh, mill finish, .011 inch (13 x 1.1 mm) wire. Secure screen within a 0.055 inch thick extruded aluminum frame.
   2. Frame: Removable. Frames to have mitered corners and corner locks.

B. Fasteners: Non-corrosive stainless steel or aluminum.

2.4 MATERIAL AND METAL FINISH

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.
B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005

C. Finish, General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process.

D. Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF or FEVE resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Finish thickness to be 1.5 to 3.0 mils. Finish to allow zero VOCs to be emitted into facility of application or at job site. Finish to adhere to a 4H Hardness rating.

   2. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

   A. Clean opening thoroughly prior to installation.

   B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

   A. Install louvers and insect screen at locations indicated on the drawings and in accordance with manufacturer's instructions and reviewed submittals.

   B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.

   C. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

   D. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

   E. Install joint sealants as specified in Section 07 92 00.

   F. Protect nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals (aluminum to steel) from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with self-adhesive flashing tape, waterproof gaskets or nonmetallic flashing.

3.4 PROTECTION AND CLEANING

   A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.
B. Clean louver surfaces in accordance with manufacturer's instructions.

C. Touch-up, repair or replace damaged products before Substantial Completion. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete floor slab to prepare it for floor covering installation.

B. Before installation of flooring finishes over interior concrete slabs, District will have concrete floor slab moisture content tests performed by an independent laboratory to determine the level of vapor emissions in the concrete slabs, the pH level, and the amount of and location where moisture vapor emission control system will be applied. District will provide copies of the test results to the Architect, Construction Manager, Project Inspector, and Contractor prior to the installation of the flooring finishes. If remedial action is indicated, it shall be performed by the Contractor in accordance with this section prior to the installation of the flooring finishes. This testing will occur before and after the moisture vapor emission control system is installed.

C. Related Requirements:
1. Section 01 40 00 “Quality Requirements”
2. Flooring Sections in Division 09.

1.3 PRE-INSTALLATION MEETINGS
A. Pre-installation Conference: Conduct conference at Project site.

1.4 DEFINITIONS
A. MVE: Moisture vapor emission.

B. MVER: Moisture vapor emission rate.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product and system specified, including:

1. Manufacturer’s Specification.

2. Manufacturer’s Material Safety Data Sheets for moisture vapor emission control system proposed for use.

3. Installation Instructions.


5. Warranty Information.

6. List of product use and performance history, for the same formulation and system design, listing reference sources. Similar projects shall have documented minimum initial vapor
emission rates of 25 lbs per 1,000 sf per 24 hrs / 100% RH and have resulted in maintained vapor reduction rate of less than 3 lbs per 1,000 sf per 24 hrs / 75% RH when tested in accordance with ASTM F 1869 and ASTM F 2170.

B. Sustainable Design Submittals:
1. Product Data: For coatings, indicating VOC content. Provide documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings
2. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   a. Environmental Product Declaration: For each product.
   b. Multi-Attribute Optimization declarations: for each product.
   c. Raw Material Source and Extraction Reports: for each product.
   d. Leadership Extraction Practices reports or certifications: for each product.
   e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and manufacturer.
1. Installer Qualifications: Employ an installer currently certified by the Manufacturer, experienced in surface preparation and application of material, and subject to the inspection and control of the Manufacturer.
2. Manufacturer Qualifications:
   a. Minimum five (5) years of manufacturing the same moisture vapor emission control products without change of formulation or system design.
   b. Manufacturer shall have independent lab test reports documenting performance per the following:
      1) ASTM E 96, Water Vapor Transmission (wet methods). Performance shall be documented by an independent testing laboratory at a minimum of 96% for vapor emission control compared to untreated ACI Committee 201 durable concrete.
      2) ASTM E 96 Permeance Rating: Product cannot exceed a 0.1 permeance rating.
      5) ASTM D 1308; Insensitivity to alkaline environment up to pH 14.
      6) Certify acceptance and exposure to continuous topical exposure after final cure.
      7) Reduce Calcium Chloride readings up to 25-lbs/1000 sq. ft. / 24 hrs. in one coat and perform as required with RH Probe readings of 100%.

B. Sample Warranty: For manufacturer’s warranty.

C. Product Test Reports: For each MVE-control system.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

B. Store products in ventilated, dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg. F. Protect from dampness, freezing, and direct sunlight.

C. Handle product in a manner that shall prevent breakage of containers and damage to products.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
   1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg. F and not more than 85 deg. F. Fat least 48 hours before use.
   2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg. F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
   3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg. F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
   4. Do not apply products to unprotected surfaces in wet weather or to substrates on which ice, frost, or water is visible.
   5. Products cannot be applied when Dew Point conditions exist. Consult the Manufacturer for specific guidelines concerning this condition.
   6. Allow continuous ventilation and indirect air movement at all times during application and curing process of the moisture vapor emission control systems.

B. Protection: Protect products to prevent damage from active rain or topical water for a minimum period of 24 hours from time of application.

1.9 SCHEDULING

A. Coordinate scheduling of testing and allow enough time for the testing, the installation of the moisture vapor emission control system, and the re-testing before installation of floor finishes.

B. Allow the concrete slab to cure for not less than 28 days before testing. Consult with the Construction Manager if an accelerated timetable is necessary.

1.10 WARRANTY

A. General Warranty: The warranties specified in this Article shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
B. Standard Manufacturer's Warranty: Submit Manufacturer's standard written warranty, signed by moisture vapor emission control systems Manufacturer agreeing to promptly repair defects in materials or workmanship for the following warranty period:
1. Standard Manufacturer's Warranty: Manufacturer shall provide the District with its standard ten (10) year warranty at no additional cost.
2. Installer's Warranty: Installer of moisture vapor emission control systems shall provide standard installation warranty for workmanship.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
1. MVER: Maximum 25 lb of moisture vapor emission /1000 sq. ft. per 24 hrs. when tested according to ASTM F 1869.
2. Relative Humidity: Maximum 100 percent when tested according to ASTM F 2170 using in situ probes.

B. Water-Vapor Emission: Through MVE-control system, maximum 0.10 perm when tested according to ASTM E 96/E 96M.

C. Tensile Bond Strength: For MVE-control system, greater than 1,000 psi at 28 days with failure in the concrete according to ASTM D 7234.

D. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.

E. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

2.2 MVE-CONTROL SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide one of the following products:
2. KOSTER American Corporation. Koster; VAP 1 2000 System.
3. MAPEI Corporation; Planiseal MVR.
4. Or equal.

B. MVE-Control System: ASTM F 3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
1. ASTM E 96, Water Vapor Transmission (dry and wet methods) Performance shall be documented by an independent testing laboratory at a minimum 96% vapor emission reduction compared to untreated ACI Committee 201 durable concrete.
2. ASTM D 1308; Insensitivity to alkaline environment up to pH 14.
3. Long-term adhesion ASTM D 7234 Adhesion Properties after ASTM E 96 when applied onto damp, fresh, or old concrete with constant vapor emission.
4. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
5. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.
6. This system shall be applied to a properly prepared concrete surface. Testing showing a pH in excess of 10 and/or vapor emission levels as indicated in specified finish flooring Sections shall determine where this system is used and the coverage rates required. The moisture vapor emission control system shall reduce vapor emissions by a minimum of 96% after final cure.

2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 4000-psi compressive strength after 28 days when tested according to ASTM C 109.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

C. Cementitious Underlayment: As recommended by the flooring manufacturer and approved by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.

B. Adhesion Tests:
   1. Verify for acceptability the proper adhesion of flooring adhesives, coatings, and leveling compounds to the final moisture vapor emission control coating system. Contact moisture vapor emission control system Manufacturer’s representative for recommendations.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Clean all surfaces to receive moisture vapor emission control system. Shot blast all floors and clean surfaces with Shop Vac to remove all residue from the substrate. Remove all defective materials and foreign matter such as dust, adhesives, leveling compounds, paint, dirt, floor hardeners, bond breakers, oil, grease, curing agents, form release agents, efflorescence, laitance, shot blast BBs, etc. Inform moisture vapor emission control system manufacturer if concrete additives like chlorides or other soluble compounds that can contaminate surfaces have been used in the concrete mix. Reinforcing fibers shall be burned off, scraped, and vacuumed. Acid etching is not allowed.

B. Prior to moisture vapor emission control system installation, repair concrete including all cracks, expansion joints, control joints, and open surface honeycombs in accordance with moisture vapor emission control systems Manufacturer’s recommendations.

C. Verify that surfaces to be treated with moisture vapor emission control systems have not previously been treated with other materials such as underlayments, screeds, penetrating sealants, etc. If this is the case, consult with the Manufacturer’s representative prior to application of moisture vapor emission control systems.
D. Only a surface substrate that remains uncontaminated and sound is fit to receive a moisture vapor emission control system. Comply with all requirements as listed in Manufacturer's technical data information.

E. Proper removal of contaminants can render surfaces too rough for certain flooring systems. Shot blast a small test area and verify with the flooring applicator that the surfaces are fit to receive the specified flooring system without the application of an underlayment on top of the moisture vapor emission control system.

F. Use clean containers and mix thoroughly as per Manufacturer's requirements to obtain a homogeneous mixture. Use a low speed motor less than 400 rpm and a two bladed Jiffy mixing blade only. Do not aerate. Mix ratios are measured by volume.

3.3 DISTRICT TESTING

A. Before installation of flooring finishes over interior concrete slabs, District will have concrete floor slab moisture content tests performed by an independent laboratory to determine the level of vapor emission in the concrete slabs, the pH level and the amount of and location where moisture vapor emission control system will be applied. If remedial action is indicated, perform such action in accordance with this section prior to the installation of the flooring finishes.

B. After installation of the moisture vapor emission control system the District will repeat the testing procedure to confirm that the vapor emission and pH levels are adequate to receive the flooring finishes.

3.4 APPLICATION

A. General: Install MVE-control system according to ASTM F 3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
   1. Install primers as required to comply with manufacturer's written instructions.

B. Vapor Emission Level Reduction System:
   1. Coverage by this system will be affected by the surface texture and porosity of the substrate as well as the measured level of moisture.
   2. Provide coverages relative to moisture vapor emissions as follows:
      a. Spread moisture vapor emission control coating onto ICRI CSP-3 shot-blasted and prepared concrete surface at a rate of no greater than 130 sq. ft./gal. in one coat. Concrete prepared to CSP-3 coated at 130 sq. ft./gal. will yield an average dry mil thickness of no less than 12 mils (0.012 in.). Moisture vapor emission control coatings must be installed at a minimum dry mil thickness of no less than 12 mils (0.012) as less dry mil thickness will result in a higher permeance of the cured coating that will not meet the performance requirements of ASTM-F 3010 and Article 2.1 of this Specification.
      3. Apply moisture vapor emission control system in accordance with manufacturer’s recommendations. Re-test after system has cured and before installing flooring finishes. Refer to additional application instructions in the Manufacturer’s technical data sheets.

C. Level and smooth surfaces as required by flooring manufacturer after shot blasting, surface preparation, and cured installation of the moisture vapor emission control system. Use an underlayment system manufactured, tested, and/or approved by the moisture vapor emission control system Manufacturer prior to installation. No underlayment system containing gypsum will be allowed. When water-based adhesives are utilized in the floor covering installation, use previously approved underlayment systems with primer that is applied directly to the moisture vapor emission control system prior to the installation of the flooring system. Coordinate with
the adhesive manufacturer for its minimum recommended thickness of cementitious underlayment to absorb excess moisture in the adhesive.

D. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

E. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

F. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

G. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

H. Install primer and cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.5 CLEANING AND PROTECTION

A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

C. Clean all tools and equipment with xylene (or other cleaning agent as recommended by the manufacturer) immediately after use when applying the moisture vapor emission control level reduction system.

D. Remove from the Project site all debris resulting from moisture vapor emission control system installation.

E. Protect each coat during specified cure period from all traffic, water, and contaminants.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes the following:
   2. Metal Lath and Metal Accessories for Plaster
   3. Portland Cement Basecoats and Polymer-modified Acrylic Finish Materials

1.2 SUMMARY OF PLASTER SYSTEMS

A. Wall System Description: Three Coat Plaster Assembly; plywood exterior sheathing board, weather-resistant barrier papers, galvanized plaster accessories, metal lath, a fiber reinforced plaster scratch and brown coat, with polymer-modified integral color acrylic finish coat.

1.3 SUBMITTALS

A. Material Certificates: For each kind of plaster aggregate indicated, submit producer's certificate evidencing that materials comply with requirements.

B. Product Data: Submit manufacturer's product data for each product specified. Submit pictures or drawings of each type of metal trim and accessory to be used.
   1. Sustainable Design (LEED) Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Samples for Verification: Prepare two 12-inch square sample plaques for each plaster finish texture and color, using materials and workmanship indicating finish to be expected in the completed work. No work is to be commenced before samples and mock-ups are approved.

D. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing plaster assemblies similar to those required for this Project, and has 2 years experience with the products to be used on this project, and has successfully completed the installation of a minimum of 50,000 square feet of the specified products.
   1. Applicator shall be approved by manufacturer of acrylic polymer finish system used.

B. Single-source responsibility: Obtain plaster products from a single manufacturer, so that a single source warranty may be supplied at the completion of the project.

C. Plan and conduct a pre-installation meeting at the project site prior to the installation of any wall materials (including mock-ups). Meeting to be attended by Architect, General Contractor, and Applicator of the system.
D. Mock-Up Installation: Prior to the installation of each type of plaster assembly, provide a sample mock-up panel of each type using materials specified for final work. The panel must be constructed as per the Architect’s size and dimension requirements (Minimum 100 Sq. Ft.) Demonstrate the proposed range of color, texture and workmanship to be expected in the completed work. Show a cut-away in the panel exposing the weather barrier and metal lath of the system on a perimeter edge of the panel. Obtain Architect’s acceptance of visual qualities of the sample panel. Maintain sample panel throughout the construction process and dispose of when project is completed.
1. Notify Architect and Construction Manager 7 days in advance of the dates and times when mock-ups will be constructed.
2. Demonstrate the proposed range of aesthetic effects and workmanship.
3. Obtain Architect’s approval of mock-ups before start of plaster Work.
4. Retain and maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed plaster Work.

E. Standards: Comply with the following:
1. California Building Code (CBC), Title 24, Part 2, Chapter 25A.
2. ASTM C 1063; Installation of Lathing and Furring for Portland Cement-Based Plaster.
3. ASTM C 926; Application of Portland Cement-Based Plaster.

F. The acrylic plaster finish coat manufacturer shall provide a local architectural technical representative to provide on-site consultation.
1. Contact technical consultant to consult the installer for the application of finish on all samples, mockups and during the actual system application.

1.5 WARRANTY

A. At the completion, the Contractor shall submit a written warranty, signed by both materials manufacturer and the applicator agreeing to repair or replace defective materials and workmanship of the plaster assembly and damaged adjacent work during the warranty period. The Contractor shall guarantee to the Owner that all work is in accordance with drawings and specifications, and that the plaster assembly is free from defects in materials and workmanship for 1 year from the date of acceptance of the Work by the Owner. Contractor shall provide a proposed copy of the warranty.

B. Defective materials and workmanship is hereby defined to include, but not to be limited to, evidence of:
1. Penetration of water into building.
2. Excessive non-uniformity, pitting, shrinkage cracking and or peeling.

C. Provide manufacturer’s printed 5-year limited warranty that exterior acrylic polymer finish systems shall be free from defects. Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 DELIVERY AND STORAGE

A. Deliver all manufactured materials in original packages, containers or bundles, bearing name of manufacturer and brand.

B. Keep plaster and all cementitious materials dry until ready for use. Keep off ground, under cover and away from damp surfaces. Protect metal goods against rusting.

1.7 PROJECT CONDITIONS

A. Warm-Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by manufacturer, climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

B. Exterior Plaster Work: Comply with manufacturer’s written instructions for environmental conditions for applying finishes. Protect plaster against freezing when ambient temperature is below 40°F (4°C) by
heating materials and providing temporary protection and heat as required by ACI 306R.

C. Protect contiguous work from soiling, spattering, moisture deterioration and other harmful effects which might result from plastering.

PART 2 - PRODUCTS

2.1 WEATHER BARRIER AND ACCESSORIES

A. Weather-Resistant Barrier Building Paper (Lower Layer): ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; and UV stabilized.
   1. Basis of Design: High-performance, flash spun-bonded olefin, non-woven, non-perforated, secondary weather barrier is based upon DuPont™ Tyvek CommercialWrap D (Drainage) and related assembly components. Equivalent products may be submitted under Section 01 25 00 provisions.
   2. Permeance: Not less than 350 g through 1 sq. m. of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).

B. Building Paper (Upper Layer): UBC Standard 14-1; FS UU-B-790A, Type 1, Style 2, Grade D. Provide “Super Jumbo Tex 60-Minute” type, as manufactured by Fortifiber Corp., or equal product.
   1. Water Vapor Transmission (ASTM E 96): 75 grams
   2. Water Resistance (ASTM D 779): >60 minutes

C. Sealing Tape: Provide Tyvek FlexWrap flashing tape, or approved equal. Provide around all exterior door and window openings per CBC Section 1402.2, drawings and manufacturer’s specifications.

D. Self-Adhesive Flashing Membrane (SAFM) and Tape: Minimum 6 inch wide, 40 mil thickness, self-adhering, non-woven fabric reinforced SBS modified rubberized asphalt membrane: Protecto Wrap Co. “PW 100/40”; GCP Applied Technologies “Vycor V40” or approved equal. Provide other widths as needed.

2.2 METAL LATH AND METAL ACCESSORIES

A. Galvanized Trims and Accessories: All G90 galvanized metal moldings shall be 26 gauge thick, installed in full ten foot min. lengths wherever possible. Molding shall be standard products as specified, meeting ASTM A 525 and A 527. Set for 7/8 inch grounds at sheathing and 1/2 inch grounds at concrete and masonry. Provide additional items not indicated, but as required or shown on Drawings, for a complete and proper installation.
   1. Manufacturers: (or approved equal)
      a. CEMCO (California Expanded Metal Company), Industry, CA (800/775-2362)
      b. Delta Star, Inc.(Superior Metal Trim), Belmont, CA (800/892-8673)
      c. Stockton Products, Orange, CA (714/998-6330)
   2. Exterior Galvanized Plaster Corneraid: Stockton # Wire-CA
   3. Exterior Galvanized/Plaster Plastic Nose Corner Bead: Stockton # Wire-PNCB
   4. Exterior Galvanized Casing Beads: CEMCO # 66 Casing Bead
   5. Inward V Screed: Superior SIV078-012G.
   6. Stockton V Screed # Metal-W S
   7. Narrow V Screed: Stockton # Metal-NVS
   8. Wide V Screed: Stockton # Metal-WVS
   11. Fasteners: ‘Grabber’ 1-1/4 to 1-5/8 inch long wafer head tech screw, as manufactured by John Wagner Associates Inc. (510/687-6606), or equal.
   12. Coordinate depth of accessories with plaster thickness and number of coats required.

G. Aluminum Trims and Accessories: Shall be manufactured of extruded aluminum, alloy 6063 T-5, .050” thick.
1. Manufacturers:
   c. Stockton Products, Orange, CA (714/998-6330).
   d. Delta Star, Inc. (Superior Metal Trim), Belmont, CA (800/892-8673)
2. Style type and size as indicated on Drawings. Provide manufacturer’s standard end cap at all open ends. Install in strict accordance with manufacturer’s recommendations.
   a. CJ” = 1/4” Channel Screed/Control Joint PA.2 (PCS-75-25/25)
   b. “RVL” = 1” Channel Screed PA.1 (PCS-75-100)
   c. Foundation weep screed FC.8 (FWS-75A),
   d. Corner Key PG.2 (PCM-75-75),
4. Aluminum Trim Finish: Clear Anodic: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

H. Metal Lath: Expanded diamond mesh lath, self-furring, weighing 2.5 lb/square yard, made from zinc-coated (Galvanized) steel sheet to produce lath complying with ASTM C 847, with ASTM A 653 G60 hot-dip galvanized zinc coating.
1. Manufacturers:
   b. CEMCO (California Expanded Metal Company), Industry, CA (800/775-2362)
   c. Western Metal Lath Co., Riverside, CA (909/360-3500).
2. Separate application of paper and lath is required. No paper backed lath (such as K-Lath) is allowed.
3. Rib Lath: Configuration; rib depth of 3/8 inch. Weight: 3.4 lbs. per sq. yd. Use at all horizontal applications where framing members are spaced over 16 inches on center.
4. Lath Attachment Devices: Devices of material and type required by referenced standards and recommended by lath manufacturer for secure attachment of lath to framing members and of lath to lath. Tie and String Wire: 18 gage galvanized.

I. Provide other materials, not specifically described but required for a complete and proper installation, as selected by Contractor, subject to Architect’s approval.

2.2 PLASTER AND RELATED MATERIALS

A. Scratch Coat (Approximately 3/8”): PAREX Fiber 47 a fiber-reinforced factory blended scratch and brown mix for three coat plaster systems conforming to ASTM C 926, or approved equal.

B. Brown Coat (Approximately 3/8”): PAREX Fiber 47 a fiber-reinforced factory blended scratch and brown mix for three coat plaster systems conforming to ASTM C 926, or approved equal.

C. Contractor’s Option to Parex Fiber 47 above: The following fibers may be added separately to Scratch and Brown Coats. Alkali-Resistant Hill Brothers Chemical Co. “Hi-Fibe P-1510” polypropylene fibers, Fibermesh Harbourite AR type glass fibers, in 1/2 inch lengths, or approved equal. Provide in proportion and density per manufacturer’s recommendations in both Scratch and Brown Coats.

D. Sand: ASTM C 897, clean, free from deleterious amounts of loam, clay, silt, soluble salts, organic matter and graded within the following limits:

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E. Cement: Regular - Type I or Type II low alkali Portland type conforming to requirements of ASTM C 150. Do NOT use plastic cement.

F. Hydrated Lime: ASTM C 206, Type S.

G. Water: Clean, potable fresh and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

H. Bonding Agent for Portland Cement Plaster: ASTM C 932; as recommended by plaster manufacturer.

2.3 ACRYLIC-BASED FINISH COAT SYSTEM

A. Factory-mixed formulation of acrylic emulsion, colorfast mineral pigments, and fine aggregates specifically recommended by acrylic-based finish manufacturer for use over portland cement plaster base coats. Polymer finish system shall consist of basecoat (where recommended by manufacturer), primer and exterior textured finish coat. Apply this finish system over cement plaster base coats. Thickness: Between 1/16 and 1/8 inch thick as recommended by manufacturer.

1. Manufacturers: Omega Products "Akroflex", Dryvit "DPR" Finish, STO, Parex or Senergy.
2. Textures and Colors: Match Architect-approved samples and mockups.
   a. CP-1 = To match Expo 258 "Colonnade"
   b. CP-2 = To match Expo 450 "Cypress"

3. Fine Sand Finish: A 1mm aggregate size finish, similar to 20/30 sand finish of stucco. Provide a tight aggregate matrix that allows for a uniform texture. This finish can be hand- or machine-applied.

4. Crack Control: Utilize the woven glass fiber reinforcing mesh in the base coat of all smooth acrylic finishes. Comply with Crack Isolation System Data Sheet OP708 as published by Omega Products International, Corona, CA.

2.4 PROPORTIONING AND MIXING

A. Proportion and mix following manufacturer’s recommendations.

B. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer. Mechanically mix at the project site; do not hand mix except where small amounts are needed, using less than one bag of plaster.

1. Use measuring devices with known volume with successive batches proportions alike.

C. Portland Cement Plaster Base Coat Mixes and Compositions: Proportion materials for respective base coats in parts by volume for cementitious materials and in parts by volume per sum of cementitious materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability. Do not add lime to factory-mixed plaster.

1. Three-Coat Work Over Metal Lath: Base coats as indicated below:
   a. Scratch Coat: 1 part portland cement, 0 to 3/4 parts lime, 2-1/2 to 4 parts sand.
   b. Brown Coat: 1 part portland cement, 0 to 3/4 parts lime, 3 to 5 parts sand.

D. Fiber Content (For jobsite-added fibers only): Add fiber to mixes above to comply with fiber manufacturer’s directions but not to exceed 2 lbs. per cu. ft. of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

E. Use absolute minimum amount of water in all mixes. Mix only as much plaster as can be used in one hour. Protect mixes from frost, contamination, and evaporation. Do not retemper mixes after initial set has occurred.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which plaster assemblies attach or abut, including installed hollow-metal frames, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of plaster assemblies. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of plastering work shall constitute acceptance of conditions.

B. Comply with Product Manufacturer’s current published instructions for installation of products or system as applicable to each type of substrate indicated.

3.2 WEATHER BARRIERS

A. Cement Plaster Underlayment: Under cement plaster, the 1st layer (against sheathing) shall be Tyvek CommercialWrap D (or approved equal). The 2nd intervening layer shall be Grade D, 60-minute paper. Provide these 2 layers under all cement plaster. Provide 2 layers of barrier paper over wood sheathing, in accordance with Calif. Building Code.

B. Self-adhesive flashing membrane to be installed at all horizontal applications, including: Wall Caps, Shelves, Parapets, Canopies and Projections. Install membrane under the building paper. Install weather barrier prior to installation of windows and doors.

C. Seal joints and penetrations through weather-resistive barrier with specified tape and fasteners prior to installation of finish material. Barrier shall be air tight and free from holes, tears, and punctures. All window and door penetrations are to be flashed and sealed per manufacturer instructions.

D. Weather-Resistive Barrier Installation: Comply with (two) manufacturer’s printed installation instructions. Cut barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations. Apply barriers to cover vertical flashing with a minimum 4 inch overlap, unless specified greater by manufacturer or governing code.
   1. Notify manufacturer’s designated representative to obtain required periodic observations of weather barrier assembly installation (minimum twice).

3.4 PLASTER ACCESSORIES

A. Plaster Trims: Install prior to the application of the metal lath.
   1. Install casing beads where plaster stops and at all plaster terminations.
   2. Install weep screed at base.
   3. Install control joints and expansion joints as indicated or as directed by Architect.

B. General: Comply with manufacturer’s instructions and referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and alignment during plastering.

C. Accessory Attachment: Attach each flange at 18 inches o.c. maximum, or as necessary to hold plumb, for vertical accessories and to coincide with framing for horizontal accessories.

D. Set accessories plumb, level and true to line, with a tolerance of 1/8 inch in 10 feet.

E. Install metal corner beads or bullnose reinforcing at external corners, as detailed.

F. Install casing beads at terminations of plaster work, except where plaster is indicated to pass through other work and be concealed by lapping work, and except where special screens, bases or frames act as casing beads including interior metal door frames.
   1. For exterior work, set casing beads 1/4 inch from abutting frames and other work (for application of sealant).
G. Control Joints: Locate as approved by Architect (by submittals) for visual effect and as follows:
   1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
      a. Vertical Surfaces: 144 sq. ft..
      b. Horizontal and Other Nonvertical Surfaces: 100 sq. ft.
   2. At distances between control joints of not greater than 18 feet o.c.
   3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
   4. Where control joints occur in surface of construction directly behind plaster.
   5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5 LATHING

A. Install metal lath according to ASTM C 1063.

B. Metal Lath: when fastening the self-furring metal lath use No. 7, Type S Wafer Head Screws that are installed minimum 6 inches on center. Metal lath shall be applied horizontally and be lapped not less than 1/2 inch at sides and 1 inch at ends. Cornerite shall be installed in all internal corners to retain position during plastering. Cornerite may be omitted when lath is continuous or when plaster is not continuous from one plane to an adjacent plane. Install according to ASTM C 1063.
   1. After the metal lath has been applied install corner reinforcement/corner aid at all exterior corners.

3.6 PLASTER INSTALLATION, GENERAL

A. All work shall be performed by skilled workmen, especially trained and experienced in this type of work.

B. Bench marks for elevation and building line offset marks for alignment shall be established on each floor level by the General Contractor, who shall be responsible for their accuracy.

C. After lines and grades have been established, and before beginning installation in any area, the Contractor shall examine all parts of the structure on which the wall is to be placed in that area. Should any conditions be found which, in his opinion will prevent the proper execution of his work, he shall report such condition in writing to the Architect. Installation work shall not proceed in that area until such conditions are corrected or adjusted to the satisfaction of the Architect. Commencement of work shall constitute acceptance of surrounding conditions.

D. Protect contiguous work from moisture deterioration and soiling resulting from application of systems. Provide temporary covering and other protection needed to prevent spattering of exterior finish coatings on other work.

E. Protect system, substrates, and wall construction behind them from inclement weather during installation. Prevent infiltration of moisture behind system and deterioration of substrates.

F. Do not use excessive water in mixing and applying plaster materials.

G. Flat Surface Tolerances: Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10 foot straightedge placed at any location on surface.

H. Plaster flush with metal frames and other built-in metal items or accessories which act as a plaster ground, unless otherwise indicated. Where plaster is not terminated at metal by casing beads, cut base coat free from metal before plaster sets and groove finish coat at the junctures with metal.

I. Corners: Make internal corners and angles square; finish external corners flush with cornerbeads.

J. Retempering of plaster will not be permitted.

K. PAREX Fiber 47 3/8-Inch Thick Scratch Coat:
1. Apply scratch coat with sufficient material to embed and fill spaces of lath and to form keys through metal lath.
2. Allow scratch to set slightly, then score surface using a metal scratching tool with teeth 1 inch apart.
3. Score scratch coat surface in direction perpendicular to direction of supporting framing.
4. Curing Scratch Coat: Allow a 2 day curing time, and maintain moist conditions by a fine fog spray applied in the morning and evening to the surface of the scratch coat for the entirety of the cure time.

L. PAREX Fiber 47 3/8-Inch Thick Brown Coat:
1. Apply brown coat over scratch coat, bring out to grounds using a metal rod to a flat and true surface free of imperfections, which would reflect in the finish coat.
2. Reconsolidate brown coat by only lightly floating after hydration of the cement has commenced and sufficient moisture has evaporated, so that surface sheen has disappeared, but before the base/brown coat has become too rigid to be moved under float. Then immediately take a steel trowel cut back around trim edges approximately 1/16th of an inch, this will allow the finish to level off flush to the trim edges.
3. Leave the base coat only slightly rough using a steel trowel to receive finish.
4. Curing Brown Coat: Allow a 7 day curing time, maintain moist conditions by a fine fog spray applied in the morning and evening to the surface of the brown coat for the first 48 hours.

M. Curing: Moist cure base coats 48 hours minimum. Do not saturate or soak; use fine fog spray. Make provisions for moist curing over weekends and holidays.
1. Protect each coat from irregular or excessive drying. Protect plaster from hot dry winds to eliminate “dry-outs” and see that required heat and ventilation are provided as necessary to eliminate “sweat-outs”.
2. Moist cure finish coat as per reference standards and if hot dry winds prevail.

3.7 APPLICATION OF ACRYLIC-BASED FINISH COAT

A. Mix and apply per manufacturer’s printed directions and specifications. Comply with ASTM C 926. Match approved samples and mock-ups for texture and color.

B. Do not apply polymer finish to Portland cement brown coat if sun is directly on wall surface and temperature is 80 degrees F. or more. Work in shade whenever possible. Do not apply polymer finish when ambient temperature is less than 40 degrees F.

C. Protect finish and basecoat surfaces from precipitation prior to, during application, and through the setting/curing period of the finish coat.

D. Mix and apply per manufacturer’s printed directions and specifications. Match approved samples and mock-ups for texture and color.

3.8 CUTTING AND PATCHING

A. Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks dents and imperfections. Repair or replace work to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects, and where bond to the substrate has failed. In all cases, cut out cracks properly, prepare and plaster full to match adjoining surfaces. Before patching, apply plaster bonding agent to edges.

B. Sand smooth troweled finishes lightly to remove trowel marks and arises.

3.9 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces which are not to be plastered. Repair surfaces which have been
stained, marred or otherwise damaged during the plastering work. When plastering work is complete, remove unused materials, containers and equipment and plaster debris.

END OF SECTION
SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior gypsum board and related accessories.
2. Tile backing panels.

B. Related Sections:
1. Section 09 58 13 “Acoustical Drywall Ceiling System”
2. Section 09 30 13 “Ceramic Tiling”

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Sustainability (LEED) Submittals:
1. Product Data: List of proposed materials with recycled content; cost, post-consumer recycled content, and secondary recycled content for each product having recycled content.
2. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   a. Environmental Product Declaration: For each product.
   b. Multi-Attribute Optimization declarations: for each product.
   c. Raw Material Source and Extraction Reports: for each product.
   d. Leadership Extraction Practices reports or certifications: for each product.
   e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
3. VOC Content Reports for Adhesives and Sealants: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants. Provide Documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.21 "Adhesive Materials Application Operations."
4. VOC Content Reports for Architectural Coatings (primers, texture coating): Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings. Provide documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."

C. Samples: For the following products:
1. Trim Accessories: Full-size Sample in 6-inch- long length for each trim accessory indicated.
2. Texture Finish: Submit 12 inch square board showing specified texture.
1.4 QUALITY ASSURANCE

A. Provide the same manufacturer for all like products.

B. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Install mockups for the following:
      a. Each level of gypsum board finish indicated for use in exposed locations.
      b. Each texture finish indicated.
   2. Simulate finished lighting conditions for review of mockups.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
   4. Remove and re-do unapproved mockups until approved by Architect.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior gypsum panels until installation areas are enclosed.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency. See Drawings for specific STC-rated assemblies.

C. Low Emitting Materials: For ceiling and wall assemblies, materials and construction shall be identical to those tested in assembly and complying with the testing and product requirements of the California Department of Public Health (CDPH) "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers (2004)" including all Addenda.

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content of Gypsum Panel Products: Gypsum board core shall be postconsumer recycled content plus one-half of preconsumer recycled content not less than 5 percent. All
gypsum board paper-facing shall be made of 100% recycled content. This does not apply to glass mat sheathing.

B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. CertainTeed Corp.
   2. Georgia-Pacific Gypsum LLC.
   4. USG Corporation.
   5. Or Equal

B. Gypsum Board: ASTM C 1396/C 1396M. Type X fire-rated. Listing: UL Listed as a component in rated assemblies as required, per ASTM E 119.
   1. Thickness: 5/8 inch and 3/8 inch, as indicated on Drawings.
   2. Long Edges: Tapered.

C. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M or ASTM C 1658. With moisture- and mold-resistant core and surfaces.
   1. Core: 5/8 inch, Type X.
   2. Long Edges: Tapered.
   4. Locations: Use at all painted walls and ceilings in restrooms, rooms containing sinks, and janitor/custodial rooms. Do not use as a base for wall tile.
   5. Products:
      a. USG: SHEETROCK Mold Tough gypsum panels.
      d. Or Equal.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. CertainTeed Corp.; GlasRoc Tile Backer.
      b. Georgia-Pacific; DensShield Tile Backer.
      c. Or Equal.
   2. Core: 5/8 inch, Type X.
   4. Locations: Use under all wall tile.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc. Paper-faced metal trim shall have lifetime warranty against edge cracking. Control joints shall be rolled zinc.
   2. Shapes:
      a. Square Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. L-Bead: L-shaped; exposed long flange receives joint compound.
   3. Manufacturers subject to compliance with ASTM C1047 and lifetime warranty:
      1) USG: SHEETROCK paper-faced metal beads
      2) Bailey: Platinum paper faced metal beads.
      3) Or approved equal.
e. Expansion (Control) Joint: 093 Control Joint. Rolled zinc; not paper faced.
   1) CEMCO 093 control joint, Clark-Western 093 control joint, or equal.

f. U-Bead: J-shaped; exposed short flange does not receive joint compound.

g. Curved-Edge Cornerbead: With notched or flexible flanges.

   1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and
         removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers
      offering products that may be incorporated into the Work include, but are not limited to,
      the following:
      a. Fry Reglet Corp.
      b. Gordon, Inc.
      c. Pittcon Industries.
      d. Or Equal.
   2. Aluminum: Alloy and temper with not less than the strength and durability properties of
      ASTM B 221, Alloy 6063-T5.
   3. Finish: Class II anodic finishes or factory-painted, baked-enamel finishes, as selected by
      Architect. Submit samples for approval.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible
   with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas,
      use setting-type joint compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and
      trim flanges, use setting-type or drying-type all-purpose compound.
   3. Fill Coat: For second coat, use setting-type or drying-type, all-purpose or drying type
      topping compound.
   4. Finish Coat: For third coat, use setting-type or drying-type, all-purpose or drying type
      topping compound.
   5. Drywall Primer:
      a. USG SHEETROCK FIRST Coat roller applied
      b. Certainteed: Pro-Roc Level V wall and ceiling primer/surfacer
      c. Or Equal.
   6. Setting Type Joint Compound:
      a. USG: USG Lightweight Setting compound; Easy Sand
      b. Certainteed: Pro-Roc Lite Sand
      c. Or Equal.
   7. All-Purpose Drying Type Compounds:
      a. USG: All-Purpose or Total or Plus Three
      b. Certainteed: Pro-Roc All-Purpose
      c. Or Equal.
   8. Drying Type Topping Compound
      a. USG: USG Topping compound
      b. Certainteed: Pro-Roc Finishing carton
      c. Or Equal.
D. Joint Compound for Tile Backing Panels:
   1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer’s written recommendations. Provide materials not specifically described but required for a complete and proper installation.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Acoustical Joint Sealant: Manufacturer’s standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Accumatic LLC; BOSS 824 Acoustical Sound Sealant.
      b. Grabber Construction Products; Acoustical Sealant GSC.
      c. Pecora Corporation; AC-20 FTR or AIS-919.
      e. USG Corporation; SHEETROCK Acoustical Sealant.
      f. Or Equal.

E. Thermal Insulation and Sound Attenuation Blankets: As specified in Section 072100 - Thermal and Acoustical Insulation.

2.8 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Non-Aggregate Finish: Premixed, vinyl texture finish for spray application.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. PABCO Gypsum.
      c. United States Gypsum Company.
      d. Or equal.

C. Texture: Double Knock-down to match approved sample and mockup.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance. Verify that all blocking, headers and supports are in place to support fixtures, cabinetry, grab bars, and similar items.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Space fasteners in panels according to governing code, referenced gypsum board application and finishing standard and manufacturer’s written recommendations.
   1. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

E. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions as required by fire resistive rating and where practically possible. Do not make joints other than control joints at corners of framed openings.

F. Form control joints with space between edges of adjoining gypsum panels. Install type 093 control joints per manufacturer’s installation requirements.

G. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant. Fit gypsum panels around ducts, pipes, and conduits.

H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

I. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

J. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

K. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer’s written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

L. Fire-Resistant Assemblies: Provide materials and application methods, including types and spacing of fasteners and wall and ceiling framing, in accordance with specifications contained in UL Fire Resistance Manual for Design Number(s) indicated, or GA 600 for the File Number(s) indicated. Joints and penetrations of fire-rated gypsum board enclosures shall be in accordance with UL test or GA requirements.

M. Install insulation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels in direction required by fire-resistance-rated assembly, and minimize end joints.
3. Stagger abutting end joints not less than one framing member in alternate courses of panels.
4. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
5. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
6. Fastening Methods: Apply gypsum panels to supports with steel drill screws. Do not use nails.

B. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members or RC-1 channels, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer’s written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

D. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer’s written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other thicknesses of gypsum board panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

C. See Section 09 30 13 “Ceramic Tiling” for further information.

3.5 INSTALLING TRIM ACCESSORIES

A. General: Attach trim according to manufacturer’s written instructions. Adhere paper-faced metal trim to gypsum board with setting type or drying type all-purpose joint compound.
B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect. Locate control joints at 30 feet on center maximum.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners unless otherwise indicated.
   2. LC-Bead: Use at exposed panel edges.
   3. L-Bead: Use where indicated.
   4. U-Bead: Use at exposed panel edges and where indicated.
   5. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings, per manufacturer's instructions.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape. Joint Treatment: Comply with ANSI A108.11.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, as indicated on Drawings, and according to ASTM C 840 and GA-214:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile and for acoustical tile. Where indicated on Drawings.
   3. Level 3: Use at surfaces receiving heavy texture finish or heavy-grade wallcoverings.
      a. This Level includes uniform application of drywall primer roller applied to the entire surface.
   4. Level 4: Use at surfaces receiving eggshell or flat paint finish, light texture finish as specified, or light-grade wallcoverings.
      a. This Level includes uniform application of drywall primer roller applied to the entire surface.
   5. Level 5: Totally smooth finish. Use at surfaces receiving no texturing and receiving semi-gloss or gloss paint finish.
   6. Primer and its application to surfaces are specified in other Division 9 Sections.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board or underlayment.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.7 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns. Match approved sample and mockup.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written instructions.
3.8 PROTECTION

A. Protect adjacent surfaces from joint compound spillage, and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board application. At completion of each segment of installation in a room or space, promptly pick up and remove from the work area all scraps, debris, and surplus material of this Section.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Provide ceramic tile installations with accessories, as required for complete installation.
   1. Metal edge strips used with tile.

B. Related Sections:
   1. Section 03 30 00: Cast-in-Place Concrete
   2. Section 07 92 00: Sealants
   3. Section 09 29 00: Gypsum Board, for wall tile backer board
   4. Section 10 28 00: Toilet Room Accessories

1.2 REFERENCES


B. ANSI A108.5: Installation of Tile with Latex-Portland Cement Mortar.


1.3 SUBMITTALS

A. Product Data: Furnish manufacturer's literature for each type of material to be provided for Project.

B. Certificates: Submit Master Grade Certification for each shipment and type of ceramic tile, signed by manufacturer and installer.

C. Samples: Furnish each type of tile and grout clearly indicating pattern, coloration and joints.
   1. Color Charts: Submit actual tile sections showing full range of colors, textures and patterns available for each type of tile.
   2. Prepare two 12" square sample panels of each selected type of tile and grout.

D. Sustainable Design Submittals:
   For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each tile product.
   2. Multi-Attribute Optimization declarations: for each tile product.
   3. Raw Material Source and Extraction Reports: for each tile product.
   4. Leadership Extraction Practices reports or certifications: for each tile product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each tile product.
   Product Data: For adhesives, indicating VOC content.
6. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials. Provide documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.
7. Laboratory Test Reports: For tile and grout sealers, indicating compliance with requirements for low-emitting materials.

1.4 PROJECT CONDITIONS

A. Provide sufficient heat and ventilation in areas where ceramic tile work is being performed, so as to allow tile to properly set.
B. Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tile: Types as indicated; porcelain tile to comply with ANSI A137.1 Specifications for Ceramic Tile for types and grades of tiles; furnish tile complying with Standard Grade requirements unless otherwise indicated.
   1. Color, Style and Pattern: As indicated on Finish Schedule and conforming to Architect-approved samples.
   2. Floor Tile: Provide non-slip units. Slip-Resistance: Dynamic Coefficient of Friction (DCOF) AcuTest of 0.42 minimum wet. (This supersedes withdrawn ASTM C1028 test method).
   4. Base and Trim: Provide complete matching trim pieces, coordinated with sizes and coursing of adjoining flat tile as directed by Architect; types as indicated, as selected by Architect where not indicated. Provide cove base trim for all tile.

B. Setting And Grouting Materials

C. Portland Cement Mortar (Thickset) Installation Materials: Per applicable ANSI standards, including ANSI A108.1A.
   1. Cleavage Membrane: Asphalt felt, ASTM D 226/D 226M, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
   2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

D. Latex Thin Set (Modified Dry-Set Mortar): Thinset bond coat, consisting of latex-cementitious mortar conforming to ANSI A118.4.
   1. Manufacturers (or approved equal):
      a. Laticrete International Inc.
      b. Bostik Construction Products/Hydroment.
c. Custom Building Products.
d. Mapei Corp.
e. MerKrete by Parex

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4

E. Latex-Cement Grout: ANSI A118.7, latex-cementitious type, uniform in color, resistant to shrinkage. Use at all walls.
1. Manufacturers (or approved equal):
   a. Laticrete International Inc.
   b. Bostik Construction Products/Hydroment.
   c. Custom Building Products.
   d. Mapei Corp.
   e. MerKrete by Parex

2. Grout Color: As scheduled, or as otherwise selected by Architect from manufacturer's complete line. Match approved samples.
3. Use unsanded grout on joints 1/8 inch or less; use sanded grout on joints greater than 1/8 inch.

F. Epoxy Mortar and Grout: Chemical-resistant, stain-resistant, and water cleanable thinset epoxy mortar and grout conforming to ANSI A118.3. Use epoxy grout at all floors.
1. Manufacturers: Same as listed above.

G. Cleaning and Sealing Materials: As recommended by tile and grout manufacturers.

H. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A666; 300 Series, exposed-edge material.
1. Basis-of-Design: Schluter Systems, or approved equal. Use the following at Tile Base as indicated: Size: 8”x24” or 4”x24” tile w/ Schluter transition type: Dilex-EHK cove shaped profile, stainless steel finish.
2. Schluter DILEX-EHK is a stainless steel, cove-shaped profile for inside wall corners, countertop/backsplash transitions, and floor/wall transitions in applications where limited movement is expected. Eliminates the need for caulking. Features a 23/32”(18.5 mm)-wide radius.


J. Marble Thresholds: ASTM C503, with a minimum abrasion resistance of 12 according to ASTM C1353 or ASTM C241/C241M and with honed finish.
1. Description: Uniform, fine- to medium-grained white stone with gray veining. Match approved sample.

K. Provide other materials, not specifically described but as may be required for a complete and proper installation, as selected by the Contractor and subject to the approval of the Architect.
   1. Do NOT use organic adhesive to set tile.

2.2 ELASTOMERIC SEALANTS

A. General: Provide manufacturer’s standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Section 079200 “Joint Sealants.” Use mold-resistant silicone type.

2.3 MIXES

A. Mix and proportion cementitious materials for site-made leveling coats, setting beds and grout as recommended by the TCNA Handbook for Ceramic Tile Installation.
B. Mix and proportion pre-mixed setting beds and grout materials in accordance with manufacturer's recommendations.

2.4 EMISSION LIMITS

A. Comply with the requirements of the California Department of Public Health's "Standard method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings."

C. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 "Adhesives Material Application Operations."

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installing tile, ensure surfaces are level.
   1. Bed Set Tile Tolerance: Maximum surface variation of 1/4" in 10'-0".
   2. Thin Set Tile Tolerance: Maximum surface variation of 1/8" in 10'-0".

B. Ensure surfaces are clean and well cured.
   1. Drains: Where indicated, ensure surfaces are properly sloped to drains.

C. Do not commence work until surface conditions are within tolerances required for proper installation; apply latex leveling material where necessary to meet required tolerances.

D. Crack Isolation Membranes: Install membrane under all floor tile, in accordance with manufacturer's recommendations. Extend membrane minimum 6" up walls.
   1. Comply with membrane manufacturer recommendations for installation of tile over crack isolation membrane.

E. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.2 INSTALLATION

Tile Setting Methods: Install tile in accordance with referenced ANSI Standards, manufacturer's specifications, and most current TCNA Handbook recommendations for type of substrate and indicated setting method.

A. Floor Tile Installation: TCNA F111 and ANSI A108.1A; reinforced cement mortar bed (thickset) with cleavage membrane over structural concrete subfloor subject to deflection.
   1. Use at mortar-set (thickset) floors over slab-on-grade.
   2. Grout: Water-cleanable epoxy grout, ANSI A 118.3 and ANSI A 108.10.
   3. Mortar Bed: Thickness to be 1-1/4-inch minimum to 2-inches maximum.
   4. Reinforcing mesh mandatory.
   6. Coordinate floor slope with floor drain locations.

B. Wall Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
4. Fasteners: Non-corrosive and nonoxidizing in wet areas. ASTM F2329.

C. Place tile in accordance with patterns indicated on Drawings, approved submittals, and as directed by Architect. Carefully plan tile layouts, ensure pattern is uninterrupted from one surface to the next and through doorways.
   1. Apply latex thin set to back of tile where necessary to ensure 100% bond between bond coat and substrate; replace tiles which break due to voids between tile and substrate.

D. Neatly cut tile around fixtures and drains; accurately form corners, base, intersections and returns. Align floor joints with base and wall joints, unless otherwise detailed.
   1. Base, Coves: Flush cove type with base grout joint on wall, cove tile on floor, unless otherwise indicated.
   2. Corners and Edges: Bullnose tile unless otherwise indicated.

E. Locate expansion joints, control joints, contraction joints, and isolation joints where indicated; where not indicated, provide as recommended by TCNA Handbook (EJ-171) and as approved by Architect. Color match the sealant to grout colors.
   1. Install special trim pieces as indicated on Drawings and in accordance with manufacturer recommendations and installation instructions, true to lines and levels indicated and in correct relationship with tile and adjacent materials.

F. Ensure tile joints are uniform in width, subject to normal variance in tolerance allowed in tile size; ensure joints are watertight, without voids, cracks, excess mortar or grout.

G. Sound tile after setting. Remove and replace hollow sounding units.

H. Allow tile to set for a minimum 48 hours prior to grouting. Grout tile to comply with recommendations of TCNA and as specified.

I. Ceramic Tile Flooring shall be stable, firm, and slip resistant, per CBC Section 11B-302.1. Leave completed installation free of broken, damaged and faulty tile.

3.3 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION
SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Sustainable (LEED) Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content.

2. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting materials.

3. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:

   a. Environmental Product Declaration: For each product.

   b. Multi-Attribute Optimization declarations: for each product.

   c. Raw Material Source and Extraction Reports: for each product.

   d. Leadership Extraction Practices reports or certifications: for each product.

   e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

   1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.

   2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   1. Suspended ceiling components.

   2. Structural members to which suspension systems will be attached.

   3. Size and location of initial access modules for acoustical panels.

   4. Items penetrating finished ceiling include, but are not limited to, the following:

      a. Lighting fixtures.

      b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
5. Perimeter moldings.

B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Comply with the California Building Code (CBC) and the Division of State Architect (DSA) Interpretation of Regulations IR 25-2.13. This includes, but is not limited to:
1. Wires.
2. Closure angles.
3. Grid members.
4. Compression struts.
5. Anchors.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to the California Building Code (CBC).

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
2. Smoke-Developed Index: 450 or less.

C. Acoustical Performance: When tested as a complete ceiling system.
1. NRC: 0.80 minimum
2. CAC: 35 minimum

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
   2. Suspension System: Obtain each type from single source from single manufacturer.

B. Acoustical Panel Standard: Provide manufacturer’s standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
   1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designs in ASTM E 1264 and not manufacturers’ proprietary product designs, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc. (Basis-of-Design)
   2. CertainTeed Corporation.
   4. Or equal.

B. Classification: Provide panels complying with ASTM E 1264 in style as indicated on Finish Legend on Interiors Drawing.

C. Edge/Joint Detail: Tegular-Reveal sized to fit flange of exposed suspension-system members.

D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer’s standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer’s standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
2. **Size:** Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.

D. **Hanger Rods and Flat Hangers:** Mild steel, zinc coated or protected with rust-inhibitive paint.

E. **Seismic Stabilizer Bars:** Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

F. **Seismic Struts:** Manufacturer's standard compression struts designed to accommodate seismic forces.

G. **Seismic Clips:** Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

H. **Hold-Down Clips:** Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

### 2.5 METAL SUSPENSION SYSTEM

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc. (Basis-of-Design: Suprafine XL)
   2. Chicago Metallic Corporation.
   4. Or equal.

B. **Style:** 9/16-inch wide Fine-Line grid, as indicated on Finish Legend. Main and cross runners to be roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 9/16-inch-wide metal caps on flanges.
   1. **Structural Classification:** Heavy-duty system.
   2. **End Condition of Cross Runners:** Override (stepped) type.
   3. **Face Design:** Flat, flush.
   4. **Cap Material:** Steel cold-rolled sheet.
   5. **Cap Finish:** White, manufacturer's factory finish.

### 2.6 METAL EDGE MOLDINGS AND TRIM

A. **Roll-Formed, Sheet-Metal Edge Moldings and Trim:** Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
   1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
   2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

### 2.7 ACOUSTICAL SEALANT AND TOUCH-UP PAINT

A. **Acoustical Sealant for Exposed and Concealed Joints:**
   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      a. Pecora Corporation.
      b. Tremco, Inc.
      c. United States Gypsum Company.
      d. Or equal.
B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  3. Sealant shall comply with the testing and product requirements of San Diego Air Pollution Control District Rule 67.0 "Architectural Coatings" and Rule 67.21 "Adhesive Material Application Operations."

C. Touch-up Paint: As recommended by manufacturer Paint type and color to match acoustical suspension system finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to the CBC, DSA, manufacturer's written instructions, reviewed submittals, and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs or steel roof deck.
9. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
   1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
   2. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
   3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
   4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
   5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: The Owner may engage a qualified special inspector to perform tests and inspections and prepare test reports the following:
   1. Compliance of seismic design.

B. Testing Agency: The Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION
SECTION 09 54 62

SUSPENDED ACOUSTICAL CEILING BAFFLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 09 51 13 – “Acoustical Panel Ceilings”

1.2 SUMMARY

A. Section includes Interior Finish Item ACT2: Ceiling baffles and suspension systems for ceilings, also referred to as “Clouds”.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
   1. Fins: Manufacturer’s 2 x 3inch rectangular felt sample in specified color.
   2. Suspension Rail: 4-inch-long sample in specified finish.

D. Evaluation Reports: For ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Suspended Acoustical Ceiling Baffles: Quantity of each suspended decorative baffle component, exposed molding, and trim equal to 5 percent of quantity installed.
1.7 QUALITY ASSURANCE

A. Comply with the California Building Code (CBC) and the Division of State Architect (DSA) Interpretation of Regulations 25-2.13, as it applies to suspension wires.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockup of one suspended baffle unit as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Remove and re-do unapproved mockups.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver suspended decorative grid components to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, abrasion, surface contamination, and other causes.

B. Handle suspended decorative grids and accessories to avoid damaging units and finishes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to the ASCE/SEI 7 and California Building Code.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

2.2 SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated. Provide systems complete with connector clips, alignment clips, leveling clips, hangers, clips, adapters, and other suspension components required to support acoustical baffle ceiling units

B. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.
   1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318, greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
   3. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Cable Suspension System and Sway Bracing: Basis-of-Design is Griplock Systems, LLC. Provide a complete seismic cable bracing system by a single manufacturer; with cables, cable clamps, cross-cable grippers, wall snap-hooks, and eye screws.
1. Sway Bracing Cable: Stainless steel 7X9 or 7X19 stranded aircraft cable, 3/32” diameter (AS-24), with factory fitted swaged steel terminals as required for the installation. Terminals shall be guaranteed to the full published break-strength of the cable.
2. Cross-Cable Grippers: CC-Unicross in bright nickel-plated finish. Locks together any two cables of any diameter from 3/64” to 1/8” at any angle to each other.
4. Eye-Screws: Sized as indicated. Bright nickel-plated or stainless-steel finish.

D. Manufacturer: Basis-of-Design is 3Form Ready-To-Go SimpleSpec 400.37-Edge:
1. Cable Coupler: 3Form Item #3-15-1639K.
2. Suspend Anchoring Kit: 3Form Item #3-15-7000K.
3. 3mm Cable: 3Form Item #3-15-0723.

2.3 SUSPENDED ACOUSTICAL CEILING BAFFLES ("CLOUDS")

A. Basis-of-Design Product: Edge Fin Contour Pattern in SolaFelt material, as manufactured by 3form, [www.3-form.com](http://www.3-form.com), Tel. 800-726-0126. As indicated in Interiors Drawings.

B. Subject to compliance with requirements, provide product indicated on Drawings as ACT2 (Acoustical Ceiling Baffle or Cloud) or comparable product by one of the following:
1. American Decorative Ceilings (ADC).
2. Armstrong World Industries, Inc.
4. USG Corporation.
5. Or approved equal.

C. Refer to the following for component and installation information:
2. 3form Edge Technical Data Sheets, Pages 1 through 14.
3. 3form Guide Specification: Section 06 06 60- Schedules for Plastic Fabrications; 3form Edge System.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install suspended units comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer’s written instructions, and approved submittals.

B. Suspend ceiling hangers from building’s structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within plenum that are not part of supporting structure or of grid suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
3. Where width of ducts and other construction within plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached and for hanger type involved.

5. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns.

C. Suspend Ceiling hangers from building's structural members and as follows. Refer to 3form "Ready To Go" SimpleSpec 400.37-Edge Installation Manual.

1. Install six suspension cables per Suspended Acoustical Ceiling Baffle assembly. Install hangers plumb and free from contact with objects that are not part of supporting structure or suspension system.

2. Secure hangers to structure, including intermediate framing members, by attaching to Threaded Wood Insert (3-15-0791). Predrill Threaded Wood Inserts in building structural members. Drill 7/16" dia. hole a minimum of 20mm deep. Use an Allen wrench to install the Threaded Insert (3-15-0791). Screw the Cable Coupler (3-15-1639) onto the Threaded Insert. Fasten the 3mm Cable (3-15-0723) using the Cable Coupler components.

E. Secure Suspended Acoustical Ceiling Baffle assembly to ceiling hanger wires using 6mm Set Screw and Edge Holder. Refer to 3form "Ready To Go" SimpleSpec 400.37-Edge Installation Manual.

D. Use sway bracing cables to prevent swaying Suspended Acoustical Ceiling Baffle assemblies during a seismic event. Baffle assemblies shall not be allowed to swing and touch any other element. Secure Suspended Acoustical Ceiling Baffle assemblies to each other and building walls.

1. Secure sway bracing cables to Suspended Acoustical Ceiling Baffle assembly suspension cables using a cross-cable gripper located close to Rail (3-70-014) as indicated in drawings.

2. Secure to building wall primary or intermediate framing members, similar to suspended cable procedure.

3. Cables attachments shall be installed level allowing the cable to slightly slack as to not apply a horizontal force on any other sway brace cables. Cables shall slack equally for a uniform appearance.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Seismic design compliance.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections as required by Governmental Code Authorities having jurisdiction.

C. Anchors will be considered defective if they do not pass tests and inspections.

D. Testing Agency to prepare tests and inspection reports.

3.4 CLEANING

A. Clean all surfaces of ceiling baffle assemblies and support systems, including suspension and sway cables. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and deformed components.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Suspension systems for perforated gypsum interior ceilings and soffits.
   2. Acoustical Insulation for perforated gypsum board ceilings.
   3. Extruded aluminum trim for ceiling height changes and material transitions.

B. Related Requirements:
   1. Section 06 10 00 “Rough Carpentry”
   2. Section 09 29 00 “Gypsum Board”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings, showing connection and trim details. Refer to Paragraph 1.5B.

C. Sustainable Design (LEED) Submittals:
   1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.
   2. Include LEED product data as specified in Section 01 81 13.
   3. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings.
   4. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
      a. Environmental Product Declaration: For each product.
      b. Multi-Attribute Optimization declarations: for each product.
      c. Raw Material Source and Extraction Reports: for each product.
      d. Leadership Extraction Practices reports or certifications: for each product.
      e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Subcontractor shall be an experienced Installer, approved and trained by product manufacturer to properly install ceiling system.
   1. Subcontractor shall provide documentation that they are certified installers of the USG Ensemble™ Ceiling System (or approved equal system).
   2. Subcontractor shall utilize approved equipment and procedures for proper installation.
B. Source Limitations: The monolithic ceiling system is to be purchased and installed by a certified single-source provider.

C. Mockups: Provide a full-thickness finish mockup for the acoustical ceiling system and substrate to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select representative surfaces and conditions for application of the substrate and finish system.
   2. Provide a mockup of at least 100 sq. ft.
   3. Apply spray-applied finish over a complete assembled substrate, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Match approved sample texture.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Remove and re-do unapproved mockups.

1.5 COORDINATION

A. Pre-installation conference: Conduct conference at project site. Coordinate all luminaires, sprinklers, exit signs and Mechanical, Electrical and Communication devices that are to be installed in the ceiling.

B. Coordinated Shop Drawings: Submit coordinated shop drawings that clearly indicate the following components for Architect Approval prior to installation. Shop drawings shall include device alignment, dimensions, center lines and indicate the following:
   1. Access panels.
   2. Ceiling devices.
   3. Ceiling framing.
   5. Control joints
   7. Light fixtures.
   8. MEP grilles.
   9. Miscellaneous items located on ceiling.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packaging and store in an enclosed shelter providing protection from damage and exposure to the elements.
   1. Store within temperature limits required by manufacturer.
   2. Store ceiling substrate panels flat.
   3. Comply with manufacturer’s requirements for safety and handling.

B. Discard joint compounds and sealants that cannot be applied within their stated shelf life.

C. Store accessory materials in a location with constant ambient temperatures of 50 to 80°F (15 to 27 °C). Avoid exposure to sustained temperatures exceeding 125 °F (52 °C).

1.7 FIELD CONDITIONS

A. Install ceiling system in an indoor environment that is climate controlled.

B. Comply with ASTM C840 requirements for interior drywall installation: Maintain room temperatures at greater than 40 °F (4.4 °C) at least 48 hours before panel installation and greater than 50 °F (10 °C) at least 48 hours before joint treatment or spray-applied finish application, and continuously during and after application.
C. Avoid exposure and protect from excessive, repetitive or continuous moisture before, during and after installation. Eliminate sources of moisture immediately.
D. Adequate ventilation shall be maintained in the working area during installation and curing period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
B. Ceiling panels and insulation shall comply with the requirements of the California Department of public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
C. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 "Architectural Coatings.

2.2 MONOLITHIC SOUND-ABSORBING GYPSUM BOARD SYSTEM
A. Basis of Design: Subject to compliance with specified project requirements, the design is based on the following: USG Interiors, LLC, "USG Ensemble™ Acoustical Drywall Ceiling."
B. Alternate manufacturers that may offer comparable systems, subject to review and approval by Architect and District, may include:
   1. Armstrong Building Solutions
   2. National Gypsum Company

2.3 FRAMING SYSTEMS
A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
B. Perforated Gypsum Board suspension system: complies with applicable requirements per ASTM C 645, direct-hung system composed of Index support bars and cross-furring drywall suspension tees that interlock.
   1. Framing System:
      a. Deflection criteria: L/240 per ASTM C635.
   2. Framing Members: Z-furring, 20 gage minimum.
   3. Attachment devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements, if applicable.

2.4 HIGHLY-ENGINEERED GYPSUM-BASED PANEL PRODUCT FOR CEILING APPLICATION
A. Highly-Engineered Acoustical Gypsum-Based Panel product for Ceiling application.
   1. Perforated non-fire rated gypsum panel with acoustically transparent scrim: complies with ASTM C1396 Non-Type X.
2. Subject to compliance with project requirements, the base panel is made from the following: USG Corporation, LLC, “USG Sheetrock® Brand EcoSmart FC 30 Ensemble™ Panels 5/8”.

3. ISO 14040 Environmental Management, Life Cycle Assessment, Principles and Framework:
   a. Carbon emissions per Product Category Rules for North American Gypsum Boards; FPInnovations – Gypsum PCR-2013: v1; Global Warming Potential of 211 kg CO\textsubscript{2} eq./1000 ft\textsuperscript{2} for Western USA.
   b. Water reduction per Product Category Rules for North American Gypsum Boards; FP Innovations – Gypsum PCR-2013: v1 yields a net use of fresh water value of 0.953 m\textsuperscript{3}/1000 ft\textsuperscript{2} for Western USA.
   c. Above criteria shall comply with LEED v.4 Materials and Resources Credit; Building Product Disclosure and Optimization – Environmental Product Declarations, Option 1.

4. UL Type Designation “FC30” (prior to modifications)

5. ASTM C 1396/C 1396M: 5/8” wallboard, non-type X (prior to modifications).

6. ASTM E136 Non-combustibility: Meets or exceeds criteria.

7. ASTM C473:
   a. Core Hardness: Meets or Exceeds 11 (ASTM C473 B)
   b. Flexural Strength (lbf).
      a. Parallel: Not less than 46.
      b. Perpendicular: Not less than 147.
   c. Nail Pull Resistance (lbf) ASTM C473 (B): Not less than 87.

8. Thickness: 5/8 inch.

9. Length: 9’-4”

10. Widths: 48”

11. Weight: 1.65-1.75 lbs./sq. ft.


2.5 ACOUSTICAL BACKER PANEL

A. Acoustical Backer Panel: USG Interiors, LLC, “USG Ensemble™ High-NRC Backer Panel”.
   1. Classification: Provide un-faced acoustical panels with the following physical attributes:
      a. NRC: Not less than 0.80.
      b. CAC: Not less than 44.
      c. Edge/Joint Detail: SQ Square.
      d. Panel Thickness: 1 inch
      e. Modular Size: 16 by 48 inches.
      f. Recycled Content: 66%.
   2. High Recycled Content Product: Classified as containing greater than 50% total recycled content. Total recycled content is based on product composition of post-consumer and pre-consumer post-industrial recycled content per FTC guidelines.

2.6 CEILING PANEL JOINT TREATMENT

A. Perforated Gypsum Board Joint Treatment.
   1. General: Comply with ASTM C 475/C 475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board:
      a. USG Sheetrock® Brand Paper Joint Tape.
      b. USG Sheetrock® Brand All Purpose Joint Compound
      c. USG Sheetrock® Brand Ensemble® Ceiling Compound
   2. Application:
      a. Joint Compound for Interior Gypsum Board: For each coat, use formulation that complies with USG Ensemble™ Acoustical Monolithic Ceiling System applied on previous and or successive coats.
3. Prefilling:
   a. At open joints or beveled panel edges, use USG Sheetrock® Brand Easy Sand setting-type Compound.
4. Embedding and First Coat:
   a. For embedding tape, use USG Sheetrock® Brand All Purpose Joint Compound and embed USG Sheetrock® Brand Paper Joint Tape.
5. Finish Coat:
   For finish coats on joints, fasteners, and trim flanges, as well as all 3 finish coats over joint tape, use USG Sheetrock® Brand Ensemble® Ceiling Compound. Finish to create a final coat equal to a Level 4 finish. DO NOT SKIM COAT OVER PERFORATIONS.

2.7 CEILING PANEL SPRAY-APPLIED FINISH

A. Acoustically Transparent Finish
   1. USG Interiors, LLC, “USG Ensemble™ Spray-Applied Finish”:
      c. Match approved sample and mockup for texture and color.

2.8 ACCESSORIES

A. Gypsum Board Trim Accessories.
   1. Trim Accessories: Galvanized steel sheet per ASTM 1047: Provide manufacturer approved and tested metal trim that is chemically compatible with the specified ceiling system.
      a. USG Sheetrock Brand Metal Trim:
         a. Corner Bead
         b. Reveal Joint
         c. L Bead
         d. U Bead
         e. Control Joint

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, verify that installed building services to not interfere with work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Direct-Mount Assemblies: Coordinate installation of direct-mount systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed at spacing required to support the Work.
   1. Furnish inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Direct Mount: Install 1"x 1" x 1" 25ga Z furring screw attached to framing. Install 16” on center. When attaching to joist Z furring will attach perpendicular to joist. Z furring will be manufactured by steel/metal stud manufacturer.

C. Install blocking to support fixtures, equipment services, demountable partition supports, or similar construction. Comply with manufacturer’s printed directions and reviewed submittals.

D. Install bracing at terminations in assemblies.

E. This product system installation is similar to a conventional drywall installation. However, there are some differences in both materials and methods of installation that make this system unique. Installers shall review and follow all directions of the manufacturer’s installation instruction guide.

F. Arrange for a minimum of two site visits by the manufacturer’s technical representative during installation of this system. USG representative for San Diego County is Mr. Roger Merchat, Tel. (760) 728-5952. Email: RMerchat@usg.com.

G. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING MOUNTING SYSTEM

A. Install 1”x 1” x 1” 25 gage Z furring either screw attached to framing. Install 16” on center to accommodate precut NRC and USG Fiberock panels. When attaching to joist Z furring will attach perpendicular to joist. Z furring will be manufactured by steel/metal stud manufacturer.

3.5 INSTALLING FIBEROCK END JOINT BACKER PANELS

A. Insert the Fiberock End-Joint Backer Panels are used to construct a “floating end-joint”. The perforated Ensemble™ panel end joints will fall between the Z Furring and be back-blocked by the Fiberock panels. This creates a taper and makes the butt joints easier to finish. Use a 15-1/2” x 48” piece of 5/8” Fiberock and lay it in the Z Furring at the perforated panel end-joint locations. Do not screw-attach the Fiberock panels to the main tees. Insert a ¼” piece of drywall as filler behind the Fiberock to bring it flush for backer screw.

3.6 INSTALLING 1” ENSEMBLE™ HIGH-NRC BACKER PANELS

A. For high NRC system performance, lay the 1” USG Ensemble™ High-NRC Backers (white side up) in the Z furring. The acoustical backers are 16” x 48” and lay into the flanges of the Z Furring. Place a screw into the opposite side of the Z Furring to hold the High NRC panel into place until Ensemble panels are installed. Installation is similar to standard lay-in ceiling panels. Do not install high-NRC backer panels where the perforated panel end joints will be located (this will vary depending on the length of the perforated panels). Do not screw attach backer panels to the main tees.

3.7 PERFORATED GYPSUM BOARD INSTALLATION

A. The USG Sheetrock Brand Ensemble™ Panels can be cut like standard Sheetrock wallboard panels using a T square and utility knife. Score the face of the panels at the desired length, making sure to cut completely through the fiberglass face scrim. Snap the panels and then cut completely through the back scrim. No marks can be made in the field of the panels unless they
are covered by USG Sheetrock® brand Ensemble™ Ceiling Compound prior to spraying. (I.e. pencil, marker, or similar).

B. Fasten the perforated panels to the Z-furring channels at 12" OC using 1-1/4" fine thread bugle head drywall screws. Fasten end-joints to the Fiberock panels at 8" OC with 1-5/8" coarse thread bugle head drywall screws. The fasteners must be in the field of the board, not the perforations. The fastener head shall be just below the surface without tearing the fiberglass scrim.

C. A router or keyhole saw can be used to cut penetrations like standard wallboard.

D. Install beads and trims using the same method as standard wallboard.

3.8 JOINT FINISHING

A. Finish the joints using the USG Sheetrock® Brand All Purpose Joint Compound, Sheetrock® Brand Paper Joint Tape, and USG Sheetrock® Brand Ensemble™ Ceiling Compound. It is imperative to finish the joints as flat and level with the surface of the board as possible. Even slightly hollow or crowned joints will show as imperfections under critical lighting after the finish is applied.

B. Embed joint tape with the All Purpose Joint Compound. This can be done by hand with a joint knife, or a standard bazooka. Wipe excess with a joint knife and allow to dry completely.

C. Spot all fastener heads with USG Sheetrock® Brand Ensemble™ Ceiling Compound using a 1" or 2" joint knife. Keep the compound area small to minimize covering the perforations.

D. After the tape and bed coat is dry, apply the first coat of USG Sheetrock® Brand Ensemble™ Ceiling Compound over the joints. This can be done using hand tools or a 12" box with the blade set flat. Check for flatness with a 20" knife.

E. Apply the first fill coat of ceiling compound to all beads and trims. Apply second coat to fasteners. Allow to dry completely. Sand joints to remove any excess joint compound. A light sanding of the entire surface will help prep for the spray process but avoid over sanding the fiberglass scrim as much as possible. Apply a finish coat to the joints using a 14" offset blade knife (or similar).

F. Apply a finish coat to all beads and trims using the appropriate width joint knife so that the possibility of shadowing is minimized. Apply a third coat to the fasteners if required. Allow to dry completely. Check all joints, beads, and trims for flatness using a 20" wide knife or straight edge.

G. All joints must be filled and leveled with the surface of the board. Crowned joints must be sanded level using a flat sander. It is important to thoroughly check each joint down the entire length for flatness, not just at a few random locations.

3.9 SPRAY-APPLIED FINISH

A. The proper spray equipment must be used to achieve acoustical performance and esthetics.

B. Contact local USG Contractor Specialty Representative for specifications of required spray equipment to apply Ensemble™ Spray-Applied Finish.

C. Mask off all areas that need protecting from overspray with plastic sheathing. Use a floor protector as required. Set up the spray machine and compressor using the proper hoses. Set the compressor to 120 psi. On the spray machine, set the material pump regulator at 70-80 psi, and the spray nozzle atomization air to 110 psi.
D. Spray Applied Finish must be thoroughly mixed prior to application. Mix it in the 4.5-gallon container prior to filling the spray machine hopper. Using a 450-rpm electric drill and a high shear paddle mixer, thoroughly blend the finish until it has a smooth, creamy consistency. Up to 20 oz. clean, potable water may be added to achieve the proper spray consistency.

E. Check for proper consistency using the material thickness gauge provided by the spray equipment manufacturer (small steel ball). If the ball sinks completely, the fine finish is ready to spray. If the ball does not sink within 3 seconds, add more water 4 oz. at a time (up to 20 oz.) and mix thoroughly until the ball sinks.

F. Prime sprayer equipment with 5 gallons of clean potable water. With the nozzle air off, cycle water through the hose and spray gun back into the hopper for 30 seconds and then drain out the water out of the hopper. Pour the 5 gallons of mixed finish into the hopper. With the nozzle air still off, cycle the remaining water out of the hose into a separate container. When the spray finish has reached the gun, cycle the spray finish through the hose and gun back into the hopper until it is flowing smoothly through the machine.

G. The Ensemble™ Spray-Applied Finish must be applied in a minimum of four coats to achieve the proper appearance and sound performance. Apply each coat very lightly with 36” minimum gun clearance. Start in one corner and work progressively across the ceiling. Immediately cross hatch. Once the finish is dry to the touch (approx. 20-40 min), use a drywall squeegee to remove excess spray droplets, then recoat using the same technique. Apply successive coats until the desired appearance is achieved and the perforations are no longer visible through the finish. Match approved mockup.

H. After the final coat, wait 24 hours and then remove any minor irregularities with a soft rubber bladed squeegee trowel.

I. Install to thickness indicated or thickness required to achieve NRC specified. Ensure that texture and color are all as per control sample/mockup.

J. Maintain proper jobsite conditions and wear proper protective equipment (safety goggles, NIOSH- approved respirator, coveralls) while applying the finish.

3.10 CLEANING AND PATCHING

A. Remove overspray and fall out materials immediately upon completion of the work in each area. Clean surfaces to remove evidence of soiling. Repair or replace damaged work surfaces to acceptable conditions.

B. Coordinate work with other work, to minimize possibility of damage to ceiling system resulting from performance of subsequent work. As other units of work are completed in each area, patch damaged areas or surfaces of finish ceiling by over spraying to match original installation, or by patching procedures as required to provide acceptable results.

END OF SECTION
SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Resilient base.
2. Resilient molding accessories.

B. Related Sections:
1. Section 09 29 00 “Gypsum Board”
2. Division 09: Various Finish Flooring Types.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
1. Environmental Product Declaration: For each product.
2. Multi-Attribute Optimization declarations: for each product.
3. Raw Material Source and Extraction Reports: for each product.
4. Leadership Extraction Practices reports or certifications: for each product.
5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
6. Laboratory Test Reports for Credit: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”
7. VOC Content Reports for Adhesives and Sealants: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.

C. Samples for Verification: For each type of product indicated, in manufacturer’s standard-size Samples but not less than 6 inches long, of each resilient product color, texture, and pattern required.

D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
      a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
      b. Flexco, Inc.
      c. Johnsonite.
      d. Mannington Commercial.
      e. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
      f. Roppe Corporation, USA.

   1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
   2. Manufacturing Method: Group I (solid, homogeneous) or Group II (layered).

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches, unless otherwise indicated.

E. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed or preformed.

H. Colors: As indicated by manufacturer's designations on Finish Schedule.
2.2 RESILIENT MOLDING ACCESSORIES

A. Description: Provide Carpet edge for glue-down applications; Nosing for carpet; Nosing for resilient floor covering; Reducer strip for resilient floor covering; Joiner for tile and carpet Transition strips.

B. Material: Rubber as indicated.

C. Profile and Dimensions: As indicated, and as required based on condition. Verify products required through submittal procedures.

D. Colors and Patterns: If not indicated, then as selected by Architect from full range of manufacturer’s colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
   1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer’s written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. **Moisture Testing:** Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
   a. **Perform anhydrous calcium chloride test, ASTM F 1869.** Proceed with installation only after substrates have maximum moisture-vapor-emanation rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. **Perform relative humidity test using in situ probes, ASTM F 2170.** Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. **Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.**

D. **Do not install resilient products until they are same temperature as the space where they are to be installed.**
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. **Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.**

3.3 **RESILIENT BASE INSTALLATION**

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. **Do not stretch resilient base during installation.**

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material or sealant.

G. **Preformed Corners:** Install preformed corners before installing straight pieces.

H. **Job-Formed Inside Corners:** Use straight pieces of maximum lengths possible.

3.4 **RESILIENT ACCESSORY INSTALLATION**

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. **Resilient Molding Accessories:** Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 **CLEANING AND PROTECTION**

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.
C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products with protective cardboard until Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes: Luxury Vinyl Plank Flooring
B. Related Requirements:
   1. Section 09 65 13 "Resilient Base and Accessories"
   2. Section 09 05 61 "Moisture Vapor Emission Control"

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency.
   2. Provide acoustical test reports indicating IIC rating of the product under a similar floor-ceiling construction.
B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   1. Show details of special patterns.
C. Samples: Full-size units of each color and pattern of floor tile required. Submit samples of acoustical floor underlayment.
D. Product Schedule: For floor tile. Use same designations indicated on Drawings.
E. Laboratory Test Reports: Adhesives and Sealants: Documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.21 "Adhesive Materials Application Operations."
   1. Submit documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.
F. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: For each product.
   3. Raw Material Source and Extraction Reports: For each product.
4. Leadership Extraction Practices reports or certifications: for each product.
5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS
A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
   1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. District will have concrete floor slab moisture content tests performed by an independent laboratory. District will submit copies of the test results to the Architect, Project Inspector, and Contractor prior to the installation of resilient tile flooring. If remedial action is indicated, perform in accordance with Section 09 05 61 “Moisture Vapor Emission Control” prior to the installation of resilient tile flooring.

C. Resilient Flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1

1.7 WARRANTY
A. Manufacturer’s Warranty: Submit manufacturer’s standard warranty document.
   1. Warranty Period: Five (5) year limited warranty commencing on Date of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS
A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Do not install resilient flooring over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by flooring manufacturer.

D. Close spaces to traffic during floor tile installation.

E. Close spaces to traffic for 48 hours after floor tile installation.

F. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm according to NFPA 253.
   2. Smoke Density: Not more than 450 according to ASTM E 662.

B. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and CBC Section 11B-302.1.

C. ASTM Standard: ASTM F1700, Class III printed film vinyl plank, Type B (embossed).

D. Emission Limits:
   2. Adhesive VOC content shall meet San Diego Air Pollution Control District Rule #67.21 "Adhesives Material Application Operations.

2.2 HIGH-PERFORMANCE LUXURY VINYL PLANK TILE

A. Basis-of-Design Product: As indicated by manufacturer's designation on Finish Schedule.
   1. Size: 6" x 48".
   2. Backing Class: Commercial grade.
   3. Added anti-microbial agents.
   4. Manufacturer's Warranty: 10 year limited commercial wear warranty.
   5. Manufacturer Test Results:
      a. IIC sound rating ASTM E492: greater than 55 when tested over 6" concrete with ceiling plenum and approved underlayment.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer’s written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient tile flooring manufacturer. Do not use solvents.

3. Verify that finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

   a. District will test concrete substrate for pH and moisture vapor emission level. Concrete must have a pH less than 10 and a moisture vapor emission level less than 3 lbs per 1,000 sf per 24 hours. If these levels are exceeded, a moisture vapor emission control system must be used before installation of resilient tile flooring.

4. If moisture vapor emission control system is not required, grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch deviation in any direction when checked with a 10-foot straight edge.

5. If moisture vapor emission control system is required, prepare substrate in accordance with Section 09 05 61 “Moisture Vapor Emission Control.”
C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
   1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
   1. Lay tiles square with room axis, unless otherwise indicated or directed by Architect.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
   1. Confirm direction of plank grain or pattern with Architect and District prior to installation.

D. Scribe, cut, and fit floor planks to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames. Where demountable partitions or other items are indicated for installation on top of resilient flooring, install resilient flooring before installing these items.

E. Extend floor tiles into toe spaces, accessible cabinets open to the floor, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Floor Tiles Requiring Adhesive Installation (by manufacturer): Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
B. Perform the following operations immediately after completing floor tile installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION
SECTION 09 68 16
SHEET CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes: Direct-glued Broadloom carpet and related carpet accessories.
B. Related Requirements:
   1. Section 09 65 13 “Resilient Base and Accessories” for resilient wall base and accessories installed with carpet.

1.3 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to carpet installation including, but not limited to, the following:
      a. Review delivery, storage, and handling procedures.
      b. Review ambient conditions and ventilation procedures.
      c. Review subfloor preparation procedures.
      d. Review protection of installed carpet.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include manufacturer’s written data on physical characteristics and durability.
   2. Include manufacturer’s written installation recommendations for each type of substrate.
B. Sustainable Design (LEED) Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
C. Shop Drawings: For carpet installation, showing the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
   2. Carpet type, color, and dye lot.
   3. Seam locations, types, and methods.
   4. Type of installation.
   5. Pattern type, repeat size, location, direction, and starting point.
   6. Pile direction.
   7. Types, colors, and locations of edge, transition, and other accessory strips.
   8. Transition details to other flooring materials.
   9. Type of carpet cushion.
D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer’s name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: 12-inch-square Sample.
2. Carpet Seam: 6-inch Sample.

E. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

F. Laboratory Test Reports: Adhesives and Sealants: Documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.21 "Adhesive Materials Application Operations."
   1. Submit documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.


1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer’s recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Build mockups at locations and in sizes shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Remove and re-do unapproved mockups.
C. District will have concrete floor slab moisture content tests performed by an independent laboratory. District will provide copies of the test results to the Architect, Project Inspector, and Contractor prior to the installation of tile carpeting. If remedial action is indicated, perform in accordance with Section 09 05 61 “Moisture Vapor Emission Control” prior to the installation of tile carpeting.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

B. Deliver carpet in original mill protective covering with mill register numbers and tags attached.

1.10 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, the following:
      a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
      b. Loss of tuft bind strength.
      c. Excess static discharge.
      d. Delamination.

B. Lifetime Limited Warranty, Covering Face Wear, Delamination, Tuft Bind, Unraveling, and Static Protection.

C. Bleach Resistant Warranty: ColorSafe with 15 Year Limited Warranty Against Color Loss from Bleach Spills.

D. Stain Resistant Warranty: XGUARD with 15 Year Limited Warranty Against Staining.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND BUILDING CODE REQUIREMENTS

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and CBC Section 11B-302.2.

B. Carpet shall be securely attached and have a firm backing. Pile height shall be ½” maximum. It shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture.
C. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length. Carpet edges shall comply with CBC Section 11B-303

2.2 SHEET CARPET


B. Roll Width: 12 feet- 6 inches.

C. Applied Treatments:
   1. Applied Soil-Resistance Treatment: Manufacturer's standard material.
   2. Antimicrobial Treatment: Manufacturer's standard material.
      a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

D. Sustainable Design Requirements:
   1. Sustainable Product Certification: Gold level certification according to ANSI/NSF 140.
   2. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Performance Characteristics:
   1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
   2. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.
   3. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
   4. Electrostatic Propensity: Less than 3.0 kV according to AATCC 134.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
   1. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 "Adhesives Material Application Operations."
   2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and buttting cut edges at backing to form secure seams and to prevent pile loss at seams.

D. Edge/Transition Strips: As specified in Section 09 65 13 "Resilient Base and Accessories".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance.
B. Examine carpet for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 30 00 “Cast-in-Place Concrete” and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
   1. Moisture Testing: Perform tests so that each test area does not exceed 400 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
      a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
      c. Perform additional moisture tests recommended in writing by adhesive and carpet manufacturers. Proceed with installation only after substrates pass testing.

D. District will test concrete substrate for pH and moisture vapor emission level. Concrete must have a pH less than 10 and a moisture vapor emission level less than 7 lbs per 1,000 sf per 24 hours. If these levels are exceeded, a moisture vapor emission control system must be used before installation of tile carpeting.
   1. If moisture vapor emission control system is not required, grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch deviation in any direction when checked with a 10-foot straight edge.
   2. If moisture vapor emission control system is required, prepare substrate in accordance with Section 09 05 61 “Moisture Vapor Emission Control.”

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

A. Comply with the Carpet and Rug Institute's CRI 104 and carpet manufacturer's written installation instructions for the following:
   1. Direct-glue-down installation.
   2. Carpet with attached-cushion installation.

B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Install pattern parallel to walls and borders, unless otherwise directed by Architect.
D. Do not bridge building expansion joints with carpet.

E. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

F. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
   2. Remove yarns that protrude from carpet surface.

B. Protect installed carpet to comply with the Carpet and Rug Institute's CRI 104.

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION
SECTION 09 84 33

SOUND ABSORBING WALL PANELS

PART 1 - GENERAL

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Custom fabricated acoustical wall panels. (Interior Finish Item AP1)

1.3 REFERENCES

A. ASTM International:

1.4 SYSTEM DESCRIPTION

A. Performance Requirements:
Surface Burning Characteristics (ASTM E84):
   a. Flamespread: 25 maximum.
   b. Smoke Developed: 250 maximum.

1.5 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.

B. Product Data: Submit product data sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.

D. Samples: Submit selection and verification samples of finishes, colors and textures.

E. Test Reports: Certified test reports showing compliance with specified performance requirements. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

F. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

6. Laboratory Test Reports: Adhesives and Sealants: Documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.21 “Adhesive Materials Application Operations.”
   a. Submit documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.

1.6 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 01 Product Requirements Section.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.7 PROJECT CONDITIONS

A. Temperatures
   1. Maintain substrate surface and ambient temperatures above 55 degrees F, unless required otherwise by manufacturer’s instructions.
   2. Do not apply adhesive when substrate surface temperature or ambient temperature is below 55 degrees F.
   3. Maintain these conditions 72 hours before, during, and after installation of vinyl wallcovering.

B. Lighting: Provide not less than 80 foot candles per square foot minimum, measured mid-height on the surfaces to receive wallcoverings.

C. Wall Condition
   1. The wall surface should be clean, dry, structurally sound, and free of mildew, grease, dust, or other stains.
   2. Remove any existing wallcovering and adhesive.
   3. Gypsum board wall surfaces should not exceed 16% moisture.
   4. Room humidity should not exceed 90%.
   5. Wall surfaces should be primed with a quality wallcovering primer as approved by manufacturer. Wall surfaces with significant color variation should be primed with a good quality pigmented wallcovering primer.

PART 2 - PRODUCTS

2.1 ACOUSTICAL WALL PANELS

A. Basis-of-Design Manufacturer: Zintra Acoustic Solution
   All Acoustical Wall Panels shall be the product of one distributor.
   Acoustical Wall Panels shall as distributed by MDC, Glendale Heights, IL [www.mdcwall.com](http://www.mdcwall.com). Contact 800-621-4006

B. Subject to conformance with specified requirements, other manufacturers offering comparable products may include, but are not limited to: Lamvin, Armstrong World Industries or equal.
2.2 MANUFACTURED UNITS

A. Zintra on Zintra Acoustic Panels
   Constructed: Perforated Polyester fiber panel bonded to another sheet of polyester fiber.
   Edges: Square. Neatly wrap fabric at edges
   Sound Absorption (ASTM C423): Noise Reduction Coefficient as follows:
      a. 1/2 inch (12.7 mm) Panel: 0.75, minimum.
   Color and pattern as indicated on Drawings.
   Panel Thickness: 1 inch (24 mm).
   Size: As indicated on the drawings; up to a maximum 48 inch x 108 inch panel.
   Mounting: Neutral Cure Silicone Adhesive or metal Z-clips

2.3 FABRICATION

A. General: Utility knife, panel saw or oscillating knife on CNC machine.

B. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

C. Dimensional Tolerances of Finished Units: Plus or minus 1/8 inch for the following:
   Thickness.
   Edge straightness.
   Overall length and width.
   Squareness from corner to corner.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor’s “Waste Management Plan” as required by Division 01 Section “Construction Waste Management.”

3.2 EXAMINATION

A. Site Verification of Conditions: Verify that substrate or supporting structure, which has been previously installed and finished under other sections, is acceptable for product installation in accordance with manufacturer’s instructions. Do not install panels until unsatisfactory conditions are corrected.

3.3 INSTALLATION

A. Compliance: Comply with manufacturer’s product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

B. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

3.4 CLEANING
A. Follow manufacturer’s instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition. Clean panels on completion of installation to remove dirt and other foreign materials according to manufacturer’s written instructions.

B. Keep site free from accumulation of waste and debris.

END OF SECTION
SECTION 09 91 13
EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Concrete.
   2. Ferrous and Non-ferrous Metal.

B. Related Requirements:
   1. Section 05 12 00 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
   2. Section 09 91 23 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit "draw-down" Samples on rigid backing, 8-1/2 x 11 inches in size.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

E. LEED Submittals:
1. Laboratory Test Reports: Architectural Coatings: For clear wood finishes, primers, and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."
2. Laboratory Test Reports: For paints and coatings, documentation indicating that they meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.5 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide a Sherwin-Williams Custodian or similar coating maintenance manual, including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Gallon cans shall be full, new and un-used.
1. Paint: Not less than 2 gallons of each material and color applied.

1.7 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
   b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Re-do unacceptable mockups until Architect’s approval is granted.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer’s original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacture’s label with the following information:

1. Product name and type (description).
2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide Sherwin-Williams Company products (Basis-of-Design) indicated, or comparable products/line from one of the following:

1. Benjamin Moore & Co.
2. Dunn-Edwards
3. Vista Paint
4. PPG

B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer’s designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Provide products that comply with standards indicated.
B. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
   1. Comply with San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings".
   3. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base, or other method acceptable to authorities having jurisdiction.

D. Colors: As indicated in a color schedule and per approved submittals.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
   1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.4 MATERIAL QUALITY

A. Provide best (premium) quality commercial-grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as standard, best grade product will not be acceptable.

B. Unless otherwise specified or approved, use paint products of one manufacturer. Oils, thinners, dryers, primers and catalysts shall be approved for use by manufacturer of paint.

C. Provide paints of durable and washable quality. Do not use paint materials which will not withstand normal washing as required to remove pencil marks, ink, ordinary soil, etc., without showing discoloration, loss of gloss, staining, or other damage.

D. Provide undercoat paint produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and use only within recommended limits.

2.5 COLORS AND FINISHES

A. Surface finish treatments, colors, and sheens are shown on drawings and indicated in "Finish Schedules" or Legend on the Drawings.

B. Prior to beginning work the Architect may furnish sample color chips for surfaces to be painted.
Match colors of sample chips and submit samples, as specified herein, before proceeding with work.

C. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon requests from other subcontractors, furnish information on characteristics of specified finish materials, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of anticipated problems using specified coating systems with substrates primed by others.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.

1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   a. Concrete: 12 percent.
   b. Masonry (CMU): 12 percent.
   c. Wood: 15 percent.
   d. Portland Cement Plaster: 12 percent.
   e. Gypsum Board: 12 percent.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove loose surface oxidation.

I. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions on product data pages.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.

F. Do not paint the following:

1. Items fully factory-finished unless specifically so indicated; materials and product having factory-applied primers are not considered factory finished.
2. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
3. Non-metallic roofing and flashing.
4. Stainless steel, anodized aluminum, bronze, and lead items.
5. Concealed pipes, ducts, and conduits.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
3.6 EXTERIOR PAINTING SCHEDULE (Basis-of-Design Products listed)

A. Concrete:

1. Acrylic Latex System:

B. Ferrous Metal, Galvanized-Metal, and Aluminum Substrates (Standard Paint Coating):

1. Acrylic Coating System:

C. Ferrous Metal, Galvanized-Metal, and Aluminum Substrates (High-Performance Coating): Use at exterior areas receiving much wear and abrasion, such as site-painted handrails, guardrails, and site-painted bollards. This does not apply to factory-finished items. Apply at locations as directed by Architect.

Ferrous Metal:
   1st Coat: SW Macropoxy 646 Epoxy B58 Series
   2nd Coat: Acrolon 100 WB Polyurethane Gloss B65 Series
   3rd Coat: Acrolon 100 WB Polyurethane Gloss B65 Series

Non-ferrous Metal:
   1st Coat: SW Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
   2nd Coat: Acrolon 100 WB Polyurethane Gloss B65 Series
   3rd Coat: Acrolon 100 WB Polyurethane Gloss B65 Series

END OF SECTION
SECTION 09 91 23
INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:
   1. Concrete.
   2. Ferrous and Non-ferrous Metal.
   3. Wood and Wood Composites
   4. Gypsum Board.

B. Related Requirements:
   1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
   2. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Sustainable Design (LEED) Submittals:
   1. Product Data: For paints and coatings, including printed statement of VOC content.
2. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit “drawn-down” samples on rigid backing, 8-1/2 x 11 inches minimum size.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

F. Laboratory Test Reports: Architectural Coatings: For clear wood finishes, primers, and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."

1.5 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide a “S-W Custodian” or similar manufacturer’s coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Gallon cans shall be full, new and un-used.
   1. Paint: provide not less than 2 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Re-do unacceptable mockups until Architect’s approval is granted.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling,
storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer’s label with the following information:
1. Product name and type (description).
2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products indicated or comparable products/line from one of the following:
   1. Benjamin Moore & Co.
   2. Dunn-Edwards
   3. Vista Paint
   4. PPG

B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
   1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Provide products that comply with standards indicated.

B. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Volatile Organic Compound (VOC) Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
   1. Comply with San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings".
3. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base, or other method acceptable to authorities having jurisdiction

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Colors: As indicated in the color/finish schedule.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.4 MATERIAL QUALITY

A. Provide best (premium) quality commercial-grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as standard, best grade product will not be acceptable.

B. Unless otherwise specified or approved, use paint products of one manufacturer. Oils, thinners, dryers, primers and catalysts shall be approved for use by manufacturer of paint.

C. Provide paints of durable and washable quality. Do not use paint materials which will not withstand normal washing as required to remove pencil marks, ink, ordinary soil, etc., without showing discoloration, loss of gloss, staining, or other damage.

D. Provide undercoat paint produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and use only within recommended limits.

2.5 COLORS AND FINISHES

A. Surface finish treatments, colors, and sheens are indicated in Finish Schedules and Interior Finish Specifications on Drawings.

B. Prior to beginning work the Architect may furnish sample color chips for surfaces to be painted. Match colors of sample chips and submit samples, as specified herein, before proceeding with work.

C. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon requests from other subcontractors, furnish information on characteristics of specified finish materials, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of anticipated problems using specified coating systems with substrates primed by others.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
   1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:
   1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
      a. Concrete: 12 percent.
      b. Concrete Masonry Units: 12 percent.
      c. Wood: 15 percent.
      d. Gypsum Board: 12 percent.
   2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."
   3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
   4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove loose surface oxidation.

I. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   1. Paint the following work where exposed in equipment rooms:
      a. Equipment, including panelboards.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
      f. Plastic conduit.
      g. Tanks that do not have factory-applied final finishes.
      h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   2. Paint the following work where exposed in occupied spaces:
      a. Equipment, including panelboards.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

F. Do Not Paint or Finish the Following Items:
1. Items fully factory-finished unless specifically so indicated.
2. Fire rating labels, equipment serial number and data labels, and operating parts of equipment.
3. Stainless steel, anodized aluminum, bronze and lead items.
4. Floors.
5. Glass.
6. Acoustical Materials
7. Concealed pipes, ducts and conduits.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates:
1. Latex System:

B. Ferrous and Non-Ferrous Metal Substrates (to match adjacent surfaces):
1. Latex System:


2. Acrylic System for Doors, Trim, and Railings:

C. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

2. Acrylic System for Doors and Trim:

D. Gypsum Board Substrates:

1. Latex System:

END OF SECTION
SECTION 09 96 23
ANTI-GRAFFITI COATING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes: Permanent anti-graffiti coating system applied to exposed exterior concrete walls and benches, and exterior cement plaster.

B. Related Sections:
   1. Section 03 30 00 – Cast-in-Place Concrete

1.2 QUALITY ASSURANCE
A. Contractor Qualifications: Installer shall be a firm with not less than three years of successful experience in application of coatings of type required on substrates similar to those of this project. The firm shall be approved by the manufacturer of the coating for installation of their product

B. Manufacturer’s representative shall inspect substrate conditions including alkalinity and moisture content. Obtain written approval from representative before proceeding with work.

C. Meets ASTM-D7089 with Cleanability at least Level 2.

D. Meets ASTM-D6578 with Cleanability at least Level 9.

1.3 SUBMITTALS
A. Submit in accordance with Section 01 33 00.

B. Instructions: Provide instructions bearing manufacturer’s name, coating type, and recommended installation procedures. Provide methods and material instruction for graffiti removal. Include adhesive-backed graffiti removal instruction label suitable for application to interior surface.

C. Submit proof of purchase (Invoice of materials purchased) and proof of delivery of coating materials.

D. Manufacturer’s Warranty: Submit one copy of manufacturer’s warranty for specified materials.

E. Field Sample: Apply graffiti resistant coating to field mock-up sample representing exterior wall surface to be coated. Apply coating system over a minimum 3 ft x 3 ft test area and test removal of applied spray paint in presence of Construction Manager for approval using removal methods recommended by the manufacturer. Remove and re-do unapproved samples.

1.4 EXTRA MATERIALS
A. Furnish the following to building owner upon completion of the Project.
   1. Provide four containers of removal products as recommended by the manufacturer accompanied by removal instructions.

1.5 DELIVERY, STORAGE AND HANDLING
A. Section 01 60 00 - Product Requirements: Transport, handle, store, and protect products.
B. Paint orders to the manufacturer or supplier shall identify the store number, location, and address of project. Contractor shall require a record keeping account be established and maintained by the paint supplier which records graffiti-resistant coating type, brand, and quantity purchased, for the specific project.

C. Deliver coating materials in sealed original labeled containers, bearing manufacturer’s name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and/or reducing.

D. Store materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F in ventilated area and as required by manufacturer’s instructions.

E. Prevent fire hazards and spontaneous combustion.

1.6 WARRANTY

A. Provide manufacturers written warranty guaranteeing effective graffiti removal for not less than 10 years and warrant that treated surfaces can be effectively and repeatedly cleaned of graffiti without damage or loss of effectiveness of the graffiti resistant coating. Manufacturer shall, for the duration of the warranty period, guarantee replacement of product where graffiti removal has shown to be ineffective.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Follow manufacturer’s recommendations for temperature range in which coating may be applied.

PART 2 - PRODUCTS

2.1 GRAFFITI RESISTANT COATING

A. Graffiti resistant coating shall be a clear, non-sacrificial graffiti resistant coating which provides protection for exterior vertical surfaces from permanent graffiti staining and damage caused by spray paint and marking pens. Coating shall be suitable for application to painted and unpainted surfaces including masonry, concrete, and metals. Product shall be of type such that recoating with the underlying paint is possible without removal of the graffiti resistant coating. Product shall be a coating that dries clear, non-yellowing, with a low luster.

1. Basis of Design Manufacturer: Rainguard Intl. Comparable products by Prosoco Sure-Klean WeatherSeal and Protectosil Chem-Trete 40 VOC by Evonik Industries or approved equal may be submitted for review.

A. Micro-Seal Water Repellant (One Coat) by Rainguard International, Newport Beach, CA 888-765-7070. (For first coat on unpainted concrete and masonry surfaces): As specified in Section 07 19 00.

B. VandlGuard Non-Sacrificial Graffiti Coating (Three Coats) by Rainguard International, Newport Beach, CA 888-765-7070.

C. Graffiti Remover: VandlClean Super graffiti remover by Rainguard International. Provide 5 gallons.

D. Emissions Limit: Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule #67.0.1 “Architectural Coatings.”

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify all surfaces are ready to receive coating in accordance with manufacturer’s printed requirements. Beginning of installation indicates acceptance of substrate.

3.2 PREPARATION

A. Surface shall be free of dirt, dust, contaminants such as curing compounds, hardeners, bond breakers, and form release. Allow painted surfaces to cure properly. Do not water blast painted surfaces. Assure surfaces are clean and dry.

B. Mask or otherwise protect adjacent surfaces not scheduled to receive coating. If applied on unscheduled surfaces such as glass, remove immediately, by approved method.

C. Protect landscaping, property, and vehicles from over spray and drift.

3.3 APPLICATION

A. Apply coating in accordance with manufacturer's published instructions and reviewed submittals.

B. Application Rate: Apply each coat at the manufacturers published application rate.

3.4 SURFACES TO BE COATED

A. Apply graffiti resistant coating to all exterior exposed concrete that is visible from the ground level, including site benches and walls, and exterior cement plaster. Exclude horizontal surfaces subject to wheel or foot traffic.

B. On building surfaces, apply coating system to first definitive continuous horizontal demarcation including change in paint color or surface material but not less than 12 feet above finish grade. Apply to full height of exterior overhead or coiling door surfaces. Apply to top of building if no definitive continuous horizontal demarcation lines exist.

3.5 MAINTENANCE

A. Deliver cleaning products to District Representative for storage and subsequent use for graffiti removal. Apply manufacturer's cleaning instructions label to interior wall location as directed by the Construction Manager.

3.6 FIELD QUALITY CONTROL:

A. Verify application rate by periodic on-site inspection (by Manufacturer's representative) and calculation of area covered compared to consumption of coating material used. Document inspections showing total area covered and number and volume of coating containers used.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 13 42 73: Integrated Interior Assemblies, for magnetic whiteboards as part of the modular partition system

1.2 SUMMARY

A. Section Includes: Manufactured visual display (markerboard) assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of any panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
3. Include sections of typical trim members.

C. Samples for Verification: For each type of visual display unit indicated.

1. Markerboard Panel: Not less than 4 inches square, with facing, core, and backing indicated for final Work.

D. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:

1. Environmental Product Declaration: For each product.
2. Multi-Attribute Optimization declarations: for each product.
3. Raw Material Source and Extraction Reports: for each product.
4. Leadership Extraction Practices reports or certifications: for each product.
5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

E. VOC Content Reports for Adhesives and Sealants: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and Sealants.
1.4 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For qualified Installer.
   B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of boards.
   C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For visual display units to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Deliver factory-fabricated markerboards completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS
   A. Environmental Limitations: Do not deliver or install markerboards until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   B. Field Measurements: Verify actual dimensions of construction contiguous with markerboards by field measurements before fabrication.
      1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY
   A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
         a. Surfaces lose original writing and erasing qualities.
         b. Surfaces exhibit crazing, cracking, or flaking.
      2. Warranty Period:

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.
2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

2.3 MARKERBOARD ASSEMBLY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Claridge Products and Equipment, Inc.
   4. Or Equal.

   2. Width and Height: As indicated on Drawings.

C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated. Porcelain enamel steel shall allow for the special magnets to work.
   1. Color: As selected by Architect from full range of industry colors.

D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
   2. Provide 1 inch wide map-rail with cork insert across entire length of each markerboard.
   3. Aluminum Finish: Clear anodic finish.

E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.

F. Combination Assemblies: Provide manufacturer's standard exposed trim between abutting sections of visual display panels.

G. Marker tray: Manufacturer's standard; continuous.
   1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.4 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive. Face shall allow for manufacturer's standard magnets to affix.
   1. Particleboard Core: 3/8 inch with 0.015-inch-thick, aluminum sheet backing.
   2. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.
2.5 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer’s standard two- or three-coat process.

B. Natural-Cork: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.

C. Hardboard: ANSI A135.4, tempered.

D. Particleboard: ANSI A208.1, Grade M-1.

E. Hardwood Plywood: HPVA HP-1.

F. Extruded Aluminum: ASTM B 221, Alloy 6063.

G. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

   1. Adhesive shall comply with the testing and product requirements of San Diego Air Pollution Control District Rule 67.0 "Architectural Coatings" and Rule 67.21 "Adhesive Material Application Operations."

2.6 ALUMINUM FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for markerboards.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer’s written instructions for surface preparation.
B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of markerboards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between markerboards and wall surfaces.

D. Prime wall surfaces indicated to receive markerboards and as recommended in writing by primer/sealer manufacturer and board manufacturer.

3.3 INSTALLATION

A. General: Install units in arrangements, locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Markerboards; Attach concealed clips, hangers, and grounds to wall surfaces and to units with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls. Blind-fasten to walls.

3.4 CLEANING AND PROTECTION

A. Clean markerboards according to manufacturer's written instructions. Attach one removable cleaning instructions label to unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect markerboards after installation and cleaning.

END OF SECTION
SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Panel signs.
   2. Room-identification door and wall signs.
   3. Exterior post-mounted signs, parking lot signs, directional signs, and Campus Map as indicated on Drawings.
   4. Contractor shall provide all engineering of sign and graphic items including but not limited to internal structure and mechanical parts. All items shall be engineered to satisfy all applicable codes and regulations.

B. Related Requirements:
   1. Section 01 50 00 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
   2. Section 05 50 00 "Metal Fabrications" for exterior pipe or tube sign supports.
   3. Section 22 05 53 "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Include plans, elevations, and large-scale sections of typical members and other components.
   3. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   4. Show typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
5. All sign copy or graphics (letters and numbers) are included in the documents for information only. Contractor shall produce film positives made by photo type position or other approved method. Large copy shall be enlarged in stages using optical, photographic or computer graphics equipment as required to achieve precise reproduction of all elements. Submit two sets of copy, with sign panel outline shown and using 1/32" minimum line weight for copy outline. Submit 3 copies of computer-generated orientation maps.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed color, pattern and surface finish.
   1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Panel Signs: Full-size Sample of one sign.
   2. Room-Identification Signs: Full-size Sample.
   3. Cast Acrylic Sheet: Manufacturer’s color charts of actual sections of material including the full range of colors available for each material required.

E. Paint and Silkscreen Ink Color Samples: Submit sample of paint and ink for review of color, sheen and texture only. Provide a listing of materials and application for each finish sample. On 6” square actual material that paint or ink is being applied to, provide 3 samples of each color, with texture to accurately depict the final finish coat. Resubmit each sample as requested until required color, sheen and texture is achieved.

F. Sign Schedule: Use same designations specified or indicated on Drawings.

G. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.
1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products or an entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Single Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

1.9 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of embedded graphic image. Cracking, crazing, peeling, blistering and other defects in materials or workmanship.
      c. Separation or delamination of sheet materials and components.
   2. Warranty Period: Two years from date of installation.

B. All vinyl shall be guaranteed for five years of outdoor durability.

C. Furnish 5 year written warranty, warranting that the factory applied linear polyurethane finishes will not develop excessive fading or excessive non-uniformity of color or shade, and will not crack, peel, pit, corrode or otherwise fail as a result of defects in material or workmanship within the following defined limits, upon notification of such defects, within the warranty period, make necessary repairs or replacement at the convenience of the Owner.
   1. Excessive Fading: A change in appearance which is perceptible and objectionable as determined by the Architect and the Owner when visually compared with the original color range standards.
   2. Excessive Non-Uniformity: Non-uniform fading to the extent that adjacent panels have a color difference greater than the original range of color.
   3. Will Not Pit or Otherwise Corrode: No pitting or other type of corrosion, discernible from a distance of 10 feet, resulting from the natural elements in the atmosphere at the project site.

PART 2 - PRODUCTS

2.1 PANEL SIGNS, GENERAL

A. Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16-inch measured diagonally.

B. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:
   1. Edge Condition: Beveled.
   2. Corner Condition: Corners rounded to a 1/2-inch radius.

C. Framed Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

D. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

E. Raised Copy: Machine-cut copy characters from matte-finished opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.

F. California Building Code Requirements for Signage and Graphics:
2. Raised Copy Thickness: Not less than 1/32-inch.
3. Character Type: Characters on signs shall be raised and shall be sans serif uppercase characters accompanied by California Contracted Grade 2 Braille.
4. Character Height (per CBC 11B-703.2.5): Raised characters shall be a minimum of 5/8-inch and a maximum of 2-inches high, based on the height of the uppercase letter ‘I’.
5. Finish and Contrast (per CBC 11B-703.5.1): Contrast between character, symbols and their background must be non-glare, either light characters on dark background or dark characters on light background.
6. Proportions (per CBC 11B-703.4 and CBC 11B-703.6): Characters on signs shall have an uppercase letter ’O’ that is 60 percent minimum and 110 percent maximum of the height of the uppercase letter ‘I’. Stroke thickness of the uppercase letter ‘I’ shall be 15 percent maximum of the height of the character.
7. Character Spacing (per CBC 11B-703.2.7): Character spacing shall be measured between the two closest points of adjacent raised characters within a message, excluding word spaces. Where characters have rectangular cross sections, spacing between individual raised characters shall be 1/8-inch minimum and 4 times the raised character stroke width maximum. Where characters have other cross section, spacing between individual raised characters shall be 1/16-inch minimum and 4 times the raised character stroke width maximum at the base of the cross sections, and 1/8-inch minimum and 4 times the raised character stroke width maximum at the top of the cross sections. Characters shall be separated from raised borders and decorative elements 3/8-inch minimum.
8. Line Spacing (per CBC 11B-703.2.8): Spacing between the baselines of separate lines of raised characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height.
9. Braille Symbols (per CBC 11B-703.3 and CBC 11B-703.4): California Contracted Grade 2 Braille shall be used wherever Braille symbols are required. Dots shall have a domed or rounded shape and shall comply with CBC Table 11B-703.3.1. The indication of an uppercase letter or letters shall only be used before the first word of sentences, proper nouns and names, individual letters of the alphabet, initials, and acronyms.
10. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40” minimum above finish floor or ground.
11. Pictograms shall comply with CBC Section 11B-703.6.
12. Symbol of accessibility shall comply with CBC Section 11B-703.7.
2.2 PERFORMANCE REQUIREMENTS

A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and CBC for signs.

2.3 WALL PANEL PLASTIC SIGNS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Sign Systems, Inc.
   2. Best Sign Systems, Inc.
   3. Vomar Products, Inc.
   4. Or equal.

B. Interior Panel Signs and Room Identification Signs: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles. Provide all signs to be only one of the following types:
   1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
      a. Composite-Sheet Thickness: 0.25 inch.
   2. Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of base sheet to produce composite sheet.
      a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
      a. Edge Condition: Squared off.
      b. Corner Condition in Elevation: Rounded to radius indicated.
   4. Mounting: Countersunk flathead through fasteners or adhesive.
   5. Surface Finish and Applied Graphics:
      a. Integral Acrylic or PVC Sheet Color: As selected by Architect from full range of industry colors.
      b. Photo-Image Graphics: Manufacturer's standard black-and-white, 600-dpi halftone or dot-screen image.
   6. Text and Typeface: Accessible raised characters and Braille. Typeface to be San Serif in Upper Case only, unless otherwise indicated. Finish raised characters to contrast with background color, and finish Braille to match background color.

C. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

2.4 EXTERIOR POST AND PANEL SIGNS (PARKING LOTS)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. APCO Graphics, Inc.
2. ASI Sign Systems, Inc.
3. Vomar Products, Inc.
4. Or equal.

B. Post and Panel Sign: Sign of single-panel configuration; with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Solid-Sheet Sign Panels: Aluminum or Galvanized steel sheet with finish specified in "Sign-Panel-Face Finish and Applied Graphics" Subparagraph below and as follows:
   a. Thickness: Manufacturer's standard for size of sign, but no less than 0.080 inch.
   b. Surface-Applied Graphics: Baked enamel or powder coat photo image.

2. Posts: Galvanized Telespar type, perforated.
   a. Shape: Square.
   b. Size: Minimum 1-3/4 inch to 2-inch square.
   c. Hot-dip galvanize post assemblies after fabrication with a minimum of 2.0 oz. of zinc/sq. ft. of surface area according to ASTM A 123.
   d. Installation Method: Direct burial.

3. Sign-Panel-Face Finish and Applied Graphics:
   a. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
   b. Photo-Image Graphics: Manufacturer's standard white, halftone or dot-screen image.
   c. Overcoat: Manufacturer's standard baked-on clear coating.

4. Silkscreening: Inks shall have a light fastness rating of 7-8 on the DIN 16525 (Wool Scale) or equivalent industry standard. Ink type shall be acceptable to the manufacturer of the substrate used. Screens shall be 254 polyester monofilament, mesh tensioned to no less than 18 newtons.

2.5 EXTERIOR MESSAGE CENTER (3-SIDED BOARDS)

A. Basis-of-Design: Model 9ZK8032 In-ground-mount, triple-sided message board with rubber tackboard upgrade. Manufacturer: Treetopproducts.com. Tel: 866-511-5642. Manufacturers that may offer equivalent products are listed in Paragraph 2.4A.

B. Characteristics:
   1. Size: 67” wide x 84” high x 58” deep. Posts are 3.5” square.
   2. Weight: 370 lbs.
   3. Acrylic plastic window, UV-resistant.
   4. Lockable doors with keys included.
   5. Color to be selected by Architect.
   6. Frame and Posts are recycled plastic.
   7. Manufacturer guarantee against breakage for 50 years.

2.6 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated. For exterior surfaces of sign, provide 3/16” flat panel (not rolled stock), alloy #3003, H14 mill
finish
or as required to meet fabrication or engineering requirements.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet per ASTM D 4802 Type UVF (UV filtering), in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg. F (80 deg. C), and of the following general types:
   1. Opaque Sheet: Provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer’s standards.

D. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for the application intended.

E. Steel Materials:
   1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, G90 coating, mill phosphatized either commercial or forming steel.
   2. Steel Members Fabricated from Plate or Bar Stock: ASTM A 529/A 529M or ASTM A 572/A 572M, 42,000-psi minimum yield strength.
   3. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.

F. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

G. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.

H. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.

I. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

J. Individual Cut-Out Letters: Provide individual cut out letters from Sintra or Acrylic in thickness and color as noted on the Drawings. Water Jet cutting as provided by Architectural Fabricators, Sacramento, CA or Equivalent.

K. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

L. Graffiti Coat: Non-yellowing, clear, hard film suitable for application on Linear Polyurethane on metal. Follow manufacturer's instructions on number of coats for exterior use using spray application per manufactures instructions. Verify gloss with Architect prior to application. Supply Architect and Owner with written directions on graffiti removal procedures per manufacturer's instructions.
2.7 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish nonferrous-metal, or hot-dip galvanized devices unless otherwise indicated.
   3. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
      b. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish insets, as required, to be set into concrete or masonry work.
      c. Fastener Heads: For nonstructural connections (wall signs), use flathead or ovalhead screws and bolts with tamper-resistant Allen-head or spanner-head slots unless otherwise indicated.
   4. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

B. Adhesive: Use liquid silicone adhesive as recommended by sign manufacturer.
   1. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 "Adhesives Material Application Operations."

C. Concrete for Post Holes: Minimum 28-day compressive strength of 2500 psi. As specified in Section 03 30 00 “Cast-In-Place Concrete,” where indicated to be used on Drawings.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.8 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   4. Internally brace signs for stability and for securing fasteners.
   5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
   1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color color unless otherwise indicated.
2. Stainless-Steel Brackets: Factory finish brackets with No. 4 finish unless otherwise indicated.

C. Exterior Posts and Panels: Shall have seamless construction with all joints filled and finished smooth, except where otherwise noted on the Design Drawings. No exposed fasteners shall be used except for access panels where approved to be attached with tamper-proof special-head screws finished to match adjacent surface/material. To prevent corrosion due to electrolysis on metal signs, separate all ferrous and non-ferrous metals with neoprene or vinyl spacers, and stainless-steel fasteners.

D. Fabrication of Exterior Campus Directory Map
   1. Silk-screen clear receptive vinyl with the pattern and wrap the post all-around starting and ending on inside center to the post. No air bubbles allowed. Provide one additional silk-screened piece of vinyl for future replacement per sign. Fabricator to supply computer-generated artwork of map for approval prior to fabricating. Map to be flood-coated vinyl.

2.9 GENERAL METAL FINISH REQUIREMENTS

   A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes'.

   B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

   C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

   D. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches as selected by the Architect from manufacturer's full range.

   E. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.10 ALUMINUM FINISHES

   A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish. Architect to approve sample color on metal prior to fabrication.

2.11 METALLIC-COATED STEEL FINISHES

   A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical
connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780/A 780M.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Location Drawings: Shall be followed when installing signs and graphic items. Item numbers which are found in the Graphic Schedule identify specific sign units and their locations. Drawings show general location for each sign. Specific location shall be determined by walking the Site with the Owner's representative and Architect. Contractor shall provide removable numbered stakes for each sign location to be placed at time of walk-through.

B. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Install signs so they do not protrude or obstruct according to the accessibility standard.

3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

C. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated on Drawings and according to accessibility standard.

D. Mounting Methods:

1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten. Architect to locate mounting holes on Shop Drawings.

2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position...
and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

E. Installation of Steel Posts for Parking Lot Signs: Pipe or Tube Mount.
   1. Vertical Tolerance: Set posts plumb within a tolerance of 1/16 inch in 3 feet.
   2. Excavation: Excavate posthole to dimensions indicated. Reconstruct subgrade that is not firm, undisturbed, or compacted soil, or that is damaged by freezing temperatures, frost, rain, accumulated water, or construction activities by excavating an additional 3-inches lower than required post bottom, with bottom of posts set at least 20 inches below finished grade, backfilling with satisfactory soil or well-graded aggregate, and compacting to original subgrade elevation.
   3. Setting in Cast-in-Place Concrete: Set post in position, support to prevent movement, and place concrete for concrete foundation as indicated.
   4. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check posts for vertical and top alignment and hold in position until concrete has achieved its final set.

F. Telespar-type Post Footings (by Unistrut or approved equal).
   1. Drive Telespar breakaway sign post footing into ground to depth recommended by manufacturer.
   2. Position Telespar perforated sign post in sign post footing and fasten with universal head-drive galvanized rivets in location to allow post to break-away from post base, as indicated.

3.3 INTERIOR SIGNAGE APPLICATIONS

A. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas, unless otherwise indicated.
   1. Sign Type: Flat signs with engraved panel media
   2. Sign Height: 3 inches, unless otherwise indicated
   3. Office Doors: Identify with room numbers (to be determined during the submittal review process). Provide clear "window" section for replaceable slide-in occupant names.
   4. Service Rooms: Identify with room names and numbers (to be determined during the submittal process).
   5. Restrooms: As indicated, to be identified with pictograms, letters, room numbers (to be determined during the submittal process) and Braille.

B. Interior Directional and Informational Signs.
   1. Sign Type: Same as room and door signs.
   2. Sizes: As indicated on Drawings.

3.4 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.
C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by District.

END OF SECTION
SECTION 10 21 13
PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:
   1. Section 05 50 00 "Metal Fabrications" for backing to attach wall-anchored compartments and screens to metal wall studs.
   2. Section 06 10 00 "Rough Carpentry" for blocking to attach wall-anchored compartments and screens to wood wall studs.
   3. Section 10 28 00 "Toilet Room Accessories" for toilet tissue dispensers, grab bars, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
   2. LEED: For recycled content, indicate postconsumer and preconsumer recycled content and cost.

B. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

C. Shop Drawings: For toilet compartments.
1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show overhead support or bracing locations.

D. Samples for Initial Selection: For each type of toilet compartment material indicated. Samples shall include all colors and patterns that are available from that manufacturer. Samples shall be of the same thickness and material as the compartment or screen.
   1. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: For the following products, in manufacturer’s standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

F. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.7 REGULATORY REQUIREMENTS PER CBC

A. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.

B. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9” high minimum above the finish floor and 6” deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12” high minimum above the finish floor for children’s use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearance at the side partition is not required in a compartment greater than 66” wide.

C. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that if the approach is to the latch side of an ambulatory compartment door, clearance between the door side of the compartment and any obstruction shall be 44” minimum. See CBC Figure 11B-604.8.2.
D. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the door near the latch.

E. Doors shall not swing into clear floor space or clearance required for any fixtures.

F. Ambulatory accessible compartments shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more fixtures. Such compartments shall be provided in the same quantity as wheelchair accessible compartments per CBC Section 11B-213.3.1 and shall comply with CBC Section 11B-604.8.2.

G. Ambulatory Accessible Toilet Compartment doors shall not swing into the clear floor space or clearance required for any fixture or into the minimum required compartment area. CBC Section 11B-604.8.2.2.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 75 or less.
   2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and CBC Title 24 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Scranton Products (Basis-of-Design)
   2. Bradley Corporation.
   4. Or equal.

B. Toilet-Enclosure Style: Overhead braced and floor anchored.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
   1. Heat-Sink Strip: Provide manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
2. Color and Pattern: One color and pattern in each room as indicated by manufacturer's designation on Finish Schedule. If not designated on Drawings, then as selected by Architect from manufacturer's full range.

E. Pilaster Shoes: Manufacturer's standard design of polymer. Color to be selected by Architect from manufacturer's complete selection.

F. Brackets (Fittings):

1. Full-Height (Continuous Length) Type: Manufacturer's standard heavy-duty design; extruded aluminum or stainless steel. For attaching panels and urinal screens to walls and pilasters.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.078-inch-thick stainless-steel continuous, cam type that swings to a closed position, allowing emergency access by lifting door. Mount with through-bolts.

2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.

3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts. Mounting height to comply with regulatory requirements for accessibility at compartments designated as accessible.


5. Door Pulls: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors. Provide pulls on both sides of doors that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel.

2.4 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221.

C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Stainless-Steel Castings: ASTM A 743/A 743M.
2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories. Provide drilled holes to receive hardware, accessories, and grab bars, as indicated.

B. Overhead-Braced Floor-Anchored Compartments: Provide manufacturer’s standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

D. In addition to other latch related information in this section, provide a slot through all doors directly behind the latch to allow the opening of the doors from the outside without lifting the doors. This “hole” shall be approximately 3/8” x 1” long and centered on the latch in the closed position. Hole shall be finished with no sharp edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer’s written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer’s recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

2. Full-Height (Continuous) Brackets: Secure panels to walls (into solid blocking or metal framing) and to pilasters with full-height brackets. Provide two adjacent continuous brackets if wainscot creates a change in wall plane.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.
B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

E. Provide backing or blocking in wall for all wall attachments.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13
PART 1 – GENERAL

1.1 WORK INCLUDED

1.1.1 Supply and installation of Automatic Vertically Retractable Acoustical Wall(s) as shown on the architectural drawings. All necessary hardware, seals, lifting machinery, electrical controls are included.

1.2 RELATED WORK

1.2.1 The main support steel beam for the wall, as well as the miscellaneous support steel for the lifting machinery for the Automatic Vertically Retractable Acoustical Wall.

1.2.2 Ceiling storage pockets along axis of Automatic Vertically Retractable Acoustical Wall.

1.2.3 Bulkheads and sound insulation above, below, and in the fixed walls at both ends of the Automatic Vertically Retractable Acoustical Wall, as per ASTM E557 - Section 07 21 00: Thermal and Acoustical Insulation.

1.2.4 All site wiring and connections for main power, including disconnect switches at each motor location. All site wiring and connections for control, including installation of key switches – Division 26.

1.2.5 This is an Alternate Bid Item. Refer to Section 01 23 00- Alternates.

1.3 SYSTEM DESCRIPTION

1.3.1 Definition

1.3.1.1 Automatic Vertically Retractable Acoustical Wall (from here on called Operable Wall) shall refer specifically to acoustical partitions that, when in the down position (closed) are hard, rigid, flat, plumb walls, made of a grid of rectangular acoustical panels, and when are lifted (opened), fold upward (vertically) without the use of any manual labor, in a manner similar to an accordion, into a pocket in the ceiling, between roof joists, or up between built in bulkheads. In the down (closed) position, the operable wall shall be comprised of two vertical planes of acoustical panels, separated by an acoustical air space.

The operable wall shall open and close in a manner similar to an accordion, in that all wall panels fold and unfold sequentially in an accordion fashion.

Standard Drive System:
The motor drive assembly is mounted directly above the centre line of the operable wall. Support steel is only required at one location.
Minimum wall length without modifying the system is 9'-0". Used for walls up to 12'-0" (3660mm) finished ceiling heights:

1.3.1.2 The operable wall shall be opened and closed using two touch screen operator stations. In the touch screen scenario, pressing and holding the up or down directional arrow symbol on one touch screen while simultaneously pressing and holding the button symbol on the second screen shall cause the wall to move in the selected direction. In both scenarios, when hand pressure is removed, the wall shall immediately stop. The operable wall shall stop in a quick and positive fashion without coasting. As a normal part of the operation, it shall be possible to partially open (or close) the wall, stop it and then reverse the operation. There
shall be two (2) touch screens per operable wall, located on opposite sides of the wall at opposite ends of the wall, wired in series. In the touch screen scenario, the screens will display faults in case of a failure with the electrical system.

1.3.1.3 From a fully open position, the operable wall shall be able to go through its entire cycle of closing and/or opening without any manual intervention.

1.3.1.4 When the operable wall is being lowered (closed) it shall come automatically to rest once it has reached the fully down (closed) position.

1.3.1.5 When the operable wall is being lifted (opened) it shall come automatically to rest once it has reached the fully up (open) position.

1.3.1.6 The operable wall shall automatically and acoustically seal against the floor without the need for any manual intervention. The floor seals shall leave a joint between the floor and the bottom acoustical panels of not more than approximately 2” (51 mm).

1.3.1.7 The operable wall shall automatically and acoustically seal against the two end walls without the need for any manual intervention. The end seals shall act in such a way as not to come into contact with the end walls while the operable wall is in motion. The end seals shall leave a joint between the acoustical panels and the end walls of no more than approximately 1” (25 mm). Guide rails with seals that rub or brush against the end walls are not acceptable. Once the operable wall reaches the full down position, the end seals shall activate automatically. The touch screen does not need to be held during the deployment of the end seals.

1.3.1.8 The operable wall shall automatically and acoustically seal against the ceiling without any manual intervention. The top seals shall leave a joint between the top acoustical panels and the ceiling of the pocket of not more than approximately 2” (51 mm).

1.3.1.9 The operable wall shall open and close at an average speed of approximately 5 to 10 vertical feet per minute (1.5 to 3 meters per minute).

1.3.1.10 When the operable wall is being lowered (closed), it shall stop if the leading (bottom) edge comes into firm contact with any object between it and the floor. The operable wall will then automatically reverse its direction and ascend for approximately 3 seconds to clear the object. The regular operation of the operable wall can resume once the obstruction has been removed.

1.3.1.11 The operable wall shall be visibly flat and rigid in the down (closed) position.

1.3.1.12 There shall be no exposed hinges, brackets, screws, and no part of the mechanical system shall be visible when the operable wall is in the down (closed) position.

1.3.1.13 All of the panel edges shall be right angled, with a minimum radius not more than 1/16” (1.6 mm).

1.3.1.14 All of the panels shall be rectangular, nominally of the same size, unless requested otherwise by the architect.

1.3.1.15 Joints between panel, vertical and horizontal, shall be no more than approximately ½” (12.7 mm) wide.

1.3.1.16 The operable wall shall stack in the up (open) position into a space no greater than 65” (1650mm) wide. The operable wall shall have a stacking height ratio in the range of 1:5 to 1:10, depending on the height of the wall.
1.3.1.17 Each acoustical panel shall be individually removable using only a screw driver. No special tools or equipment shall be required. The removal of a single acoustical panel shall not affect, dislocate or cause the removal of any adjacent panels or other acoustical panels.

1.3.1.18 The operable wall shall not weigh more than 6.2 lbs per square foot. The preceding weights do not include the motor drive or the architectural finish on the acoustical panels and are based on 24'-0" long x 12'-0" high (7315mm x 3660mm) operable wall.

1.3.1.19 A completely functioning operable wall, tested in full accordance and compliance with ASTM E90 (ISO 140-3), shall achieve, from an independent laboratory, a Sound Transmission Class (STC) rating (Rw value) of not less than the following:

System STC 51 (Rw 51), Panel Construction STC 61 (Rw 60)

1.3.1.21 The operable wall shall be designed to have a design life of at least 10,000 complete closed to opened to closed cycles.

1.4. QUALITY ASSURANCE

1.4.1. The products herein specified established the standard of quality for the operable wall based on the following Skyfold Zenith® Automatic Vertically Retractable Acoustic Walls by Skyfold Inc. Basis-of-Design:

Skyfold Zenith® 51, System STC 51 (Rw 51), Panel Construction STC 61 (Rw 60)

Proposals for substitution of products or techniques not conforming to these specifications must be submitted at least ten (10) days prior to bidding. Independent test reports which meet the requirements and design specified herein must be submitted to obtain approval.

1.4.2 All work and materials specified herein, shall be installed only by qualified representatives and/or installers and/or distributors of the manufacturer, according to the manufacturer's written instructions.

1.4.3 The operable wall must be manufactured by a certified ISO-9001-2008 company or an equivalent quality control system.

1.5 REFERENCES

1.5.1 ASTM E90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

Annex A1.15 Operable (Folding or Sliding Walls)
Annex A1.15.3 Operation – “The specimen shall not be designated an operable wall unless it opens and closes in a normal manner. It shall be fully opened and closed at least five times after installation is completed and tested without further adjustments.”

1.5.2 ASTM E413, Classification for Rating Sound Insulation.

1.5.3 ASTM E557, Standard Practice for Architectural Application and Insulation of Operable Partitions.

1.5.4 ISO 354, Measurement of Sound Absorption

1.5.5 ISO 140-3, Measurement of Airborne Sound Insulation

1.5.6 ASTM C423, Measurement of Sound Absorption
1.6 SUBMITTALS

1.6.1 Submit manufacturers’ technical data for each type of operable wall specified herein.

1.6.2 Submit shop drawings showing complete layout of operable wall system based on field verified dimensions. The drawings shall include dimensional relationship to adjoining work. Include details indicating materials, finishes, tolerances, and methods of attachment to building steel and electrical requirements.

1.6.3 Submit certified test reports evidencing compliance to acoustical STC (Rw) requirements as specified in paragraph 1.3.1.20 and in accordance to references listed in paragraphs 1.5.1 and 1.5.5.

1.6.4 LEED Sustainable Design Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

1.7 SITE CONDITIONS

1.7.1 The floor underneath the operable wall along its axis, shall be flat to within +/- ¼” (6 mm) over the entire length of an operable wall. The peak to valley undulation of +/- ¼” (6 mm) shall not be closer together than 24” (610 mm) and a peak to valley undulation of +/- 1/8” (3 mm) shall not be closer than 12” (305 mm).

1.7.2 Support steel above the operable wall along its axis shall be parallel to the floor within +/- ½” (12.7 mm) for the entire length of the operable wall. This includes loaded deflection. The beam must also be parallel to the centre line of the wall within ± 1/8” (3 mm), left to right.

1.7.3 The fixed walls at either end of the operable wall shall be within +1/4” (6 mm)-0”, from plumb vertical.

1.7.4 The fixed walls at either end of the operable wall shall be flat to within +0”, -1/4” (6 mm).

1.8 WARRANTY

1.8.1 Basic Warranty: The operable wall shall be warranted free from defects in material and workmanship for a period of two (2) years or five thousand (5,000) cycles, whichever occurs first, from the date of shipment. Extended Parts Warranty (optional): An extended warranty on parts (excluding touch screen operator stations) is available in addition to the basic warranty. It includes coverage on all parts for a period of ten (10) years or five thousand (5,000) cycles, whichever occurs first from date of shipment. Refer to Owner’s manual for full warranty details.

1.8.2 Acoustical Performance: The operable wall shall retain its acoustical properties for 10 years from the date of shipment providing proper maintenance has been performed on the partition.

1.8.3 Parts and labor required to maintain the operable wall and part subject to normal wear and tear are not covered under the warranty and are the owner’s responsibility. (Refer to Maintenance Program).
PART 2 – PRODUCTS

2.1. BASIS OF DESIGN MANUFACTURER

2.1.1 Skyfold Zenith® Automatic Vertically Retractable Acoustic Walls as manufactured by Skyfold Inc. Contact: Partition Specialties Inc. 562-577-1822.
Web-site: www.skyfold.com

Skyfold Zenith® 51 System STC 51 (Rw 51), Panel Construction STC 61 (Rw 60)

2.1.2 Alternate systems equal to can be used if they meet or exceed the performance criteria outlined in Part 1 - General above and if they are approved according to the provisions of 1.4.1 above, and of Section 01 25 13 “Product Options and Substitutions.”

2.2 MATERIALS

2.2.1 Acoustical Panels

2.2.1.1 Acoustical panels shall be faced with steel and furnished with:
White Magnetic Marker Board Surface
Lampre white marker board surface shall not ghost.

2.2.1.2 Acoustical panels, together with all of the sound insulation, shall be, as much as possible, made of non-combustible or fire-treated materials.

2.2.1.3 Acoustical panels shall be fabricated to be as stiff as possible in order to satisfy the rigid criteria when the operable wall is down (closed) and to ensure that there is no interference between panels when the wall is in motion.

2.2.1.4 Acoustical panels shall be architecturally flat with no bowing, oil canning, warping, waviness or any other surface deformation and discontinuity.

2.2.2 Folding Mechanism

2.2.2.1 The hanging, folding and extension mechanism shall be, as much as possible, made from structural grade aluminum extrusions and structural shapes, in order to minimize the weight of the system.

2.2.2.2 All wear surfaces, such as bushings, spacers, pins, discs, bearings, and sleeves shall be designed to function quietly and with minimum wear, over the 10,000 cycle design life of the operable wall.

2.2.2.3 The hangers, which fasten the lifting mechanism to the support steel, shall be fabricated from steel and shall be welded or bolted to the support steel supplied by others.

2.2.3 Motor Drive

2.2.3.1 The motor drive shall be sized properly so that it can open and close the operable wall effectively over the 10,000 cycle design life of the wall, at the minimum design speed specified in point 1.3.2.8.

2.2.3.2 The folding mechanism shall be designed to function as smoothly, quietly and safely as possible. Wherever possible, ball bearings shall be used instead of bushings and wear surfaces. In no circumstance shall chain or belt drive systems be acceptable.
2.2.3.3 There shall be a wire rope cable for every set of folding mechanism. This cable shall be of 6 x 31 construction aircraft cable and shall be made of galvanized steel. The diameter of the cables shall be sized so that they shall be able to hold the entire weight of the operable wall, with the appropriate safety factor.

2.2.3.4 The cable wraps on yoyo drums with 2 safety wraps and multiple layers of cable.

2.2.3.5 The line shaft, sized to deliver the required torque with minimum deflection, shall support and rotate the cable drums.

2.2.3.6 Flange bearings shall be used for the drive system, located immediately on both sides of the drum assembly.

2.2.3.7 The motor drive shall be sized to deliver sufficient amount of torque to safely and effectively raise and lower the operable wall over its design life.

2.2.3.8 The motor drive shall use the latest in industry standards in thermal protection, overload protection, quick acting fuses, etc., in order to ensure the safety and reliability of the system.

2.2.4. Safety Equipment

2.2.4.1 The operable wall shall employ an electromagnetic type of brake which shall activate firmly, without hesitation, when power is lost to the system. This brake shall have a minimum retarding torque rating equal to 200% of the motor drive’s full load torque. The drive system shall be equipped with a manual override and a brake release lever.

2.2.4.2 The operable wall shall employ a dynamic brake, distinct and separate from the brake in 2.2.4.1, in order to lower the operable wall at a controlled speed of no more than approximately 150% of the normal down speed, in the case of a catastrophic failure in the motor drive’s power train. Alternately, the operable wall shall employ a brake, distinct and separate from the brake in 2.2.4.1, in order to completely halt the downward motion of the wall in the case of a catastrophic failure in the power train.

2.2.4.3 The operable wall shall employ electrical or other limit switches in order to stop the wall at its up and down travel limits.

2.2.4.4 The operable wall shall employ an over torque detector in order to sense a jam in the system and to act as an over travel limit in the up direction should the primary limit switch fail to act in 1.3.2.4. This over torque sensor shall be mechanical, using the motor’s torque arm in its over torque detection.

2.2.4.5 The entire length of the bottom edge of the operable wall shall be equipped with a continuous pressure sensing strip which shall cut power to the motor drive and shall activate the brake outlined in 2.2.4.1, if the sensing edge comes in firm contact with an object, before the operable wall is in the full down (closed) position. The operable wall will automatically reverse direction and ascend for approximately 3 seconds to clear the obstruction. The power shall remain cut to the motor drive until the switches have been released. The operation of the operable wall can resume once the obstruction is removed.

2.2.5 Electrical

2.2.5.1 The operable wall shall be equipped for a three phase power supply to the electrical control box.

2.2.5.2 Standard electrical control box will be NEMA 1.
2.2.5.3 Low voltage wiring (by others). 18 gauge wiring from the switches to the control box.

2.2.5.4 Touch Screen Operator Stations Two (2), 4.3” resistive LCD touch screens, wired in series with multilingual capabilities and 4-digit adjustable user pin. The screens will display faults in case of a failure with the electrical system. (wiring by others). Key switches are not acceptable.

2.3. FABRICATION

2.3.1 Factory assemble all components, assemblies and systems into the largest possible assemblies in order to minimize the amount of assembly on site.

PART 3 – EXECUTION

3.1 INSPECTION

3.1.1 Inspect the relevant aspects of the site such as the evenness of the floor, walls, structural steel, etc., and ensure that these are within the tolerances stated in Part – 1 of this specification.

3.1.2 Confirm in writing to the General Contractor or contract manager any deviations from these tolerances. Do not proceed until these conditions are made good.

3.1.3 Carry out all appropriate field measurements before manufacturing any components or assemblies.

3.2 INSTALLATION

3.2.1 Install operable walls in accordance with the manufacturer’s printed instructions and reviewed submittals.

3.2.2 The operable wall supplier shall not deliver or install this product until the General Contractor can ensure in writing safe storage and protection for the operable wall for the duration of the project.

3.2.3 Coordinate electrical work the Division 26 provisions.

3.3 ADJUSTING AND CLEANING

3.3.1 Adjust and fine-tune the operable walls to ensure that all seals are operating and sealing properly and that the operable walls are in correct and smooth operation.

3.3.2 Clean up any dirt, oil, grime, etc., that may have found its way onto the acoustical panels. Leave the operable wall in a state of architectural cleanliness.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Washroom accessories.
   2. Under-lavatory guards.
   3. Custodial accessories.

B. Related Requirements:
   1. Section 09 30 13 "Ceramic Tiling".
   2. Section 10 21 13 "Plastic Toilet Compartments"
   3. Section 12 36 61 "Quartz Agglomerate Countertops"
   4. Section 22 42 46 "Combination Water Tap and Electric Hand Dryer Units"

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Include electrical characteristics.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.
1.7 QUALITY ASSURANCE

A. Regulatory and Code Requirements: Install toilet and bath accessories per ADA-ABA and CBC Title 24 access requirements.
   1. Accessible toilet accessories shall be mounted at heights and at horizontal locations according to CBC Title 24.
   2. Toilet paper dispensers and feminine napkin disposal units located on the grab bar side of an accessible toilet room or stall shall not project more than 3-inches from the finished wall surface nor be located closer than 1-1/2-inch clear of the tangent point of the grab bar.

1.8 WARRANTY

A. Manufacturer’s Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from a single source and from a single manufacturer.

B. Toilet Room Accessories: Basis-of-Design Products: Model numbers indicated herein are generally for products manufactured by Bobrick Washroom Equipment Co. Subject to compliance with specified requirements, provide the named products or comparable products by one of the following:
   1. A & J Washroom Accessories, Inc.
   2. American Specialties, Inc.
   3. Bradley Corporation
   4. General Accessories Manufacturing Co. (GAMCO)
   5. Or approved equal

2.2 UNDER-LAVATORY GUARDS

A. Under-lavatory Guard
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Plumberex Specialty Products, Inc.
      b. Truebro by IPS Corporation.
      c. Or equal.
   2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
   4. Provide at each exposed lavatory piping.

2.3 TOILET ROOM ACCESSORIES

A. Combination Toilet Paper Dispenser, Seat Cover Dispenser, and Sanitary Napkin Disposal (Women's and Gender-Neutral Restrooms): Double roll, stainless steel unit with pivot hinge,
3. Partition-mounted (Serves two toilet compartments): Basis-of-Design Product is Bobrick B-357.

B. Combination Toilet Paper Dispenser, Seat Cover Dispenser (Men's Restrooms): Type 304 Stainless steel. Flanges shall be drawn and beveled, one-piece, seamless construction. Accommodates 2 rolls of toilet tissue.

   1. Locate one at each sink.
   2. Provide AC Adaptor (Sloan Part Number 0346090). Coordinate wiring with electrical work.
   3. Provide a GFI outlet.

D. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Size: 18x36 inches unless otherwise noted.
   2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
   4. Product: B-165 1836 manufactured by Bobrick.

E. Recessed Waste Receptacle: Basis-of-Design Product is Bobrick B-43644; Contura Series.
   Type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Flange shall be drawn, one-piece, seamless construction. Waste receptacle shall have a formed, one-piece, seamless, removable front panel with top edge hemmed. Waste receptacle shall be equipped with Bobrick “LinerMate” to facilitate installation and removal of disposable trash liners and retains liner inside waste receptacle. LinerMate trash liner holder is fabricated with a molded plastic bag holder sleeve and a 20-gauge stainless steel, U-shaped support strap; riveted construction. Bag holder shall have an arc at front and same shape as inside of waste receptacle area. Capacity of waste receptacle: 12.8-gallons.

   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.
      d. Finishing: Satin Finish. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges.

G. Baby Diaper-Changing Station: Basis-of-Design Product is Koala Kare Products KB110-SSWM. Size: 20” H. x 35-1/4” W. x 19” extended depth.
   Baby changing station shall have 18-gauge satin stainless steel exterior finish with high-density polyethylene with Microban antimicrobial interior. Design of unit shall be surface-mounted. Unit shall be equipped with a pneumatic cylinder for controlled opening and closing of bed. Bed shall be secured to back plate with a concealed, full-length steel-on-steel hinge. Unit shall have Microban® antimicrobial embedded into plastic material. No hinge structure shall be exposed on interior or exterior surfaces. Unit shall have 11-gauge steel mounting plates with mounting hardware included. Unit shall conform to ICC A117.1-2009 Accessible and Usable Buildings and Facilities, ASTM F 2285-04 Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use, ANSI Z535.4 Product Safety Signs and Labels.
and ASTM G21 Antifungal Standards or local code if more stringent installation requirements are applicable for barrier free accessibility. Unit shall comply with ADA regulations when properly installed. Bed shall have smooth concave changing area with a nylon safety strap and two hooks for bags or purses. Unit shall have a built-in Liner Dispenser for use with 3-ply chemical free biodegradable sanitary liners, universal instruction graphics and safety messages in 6 languages. Unit shall be backed by manufacturer’s 5-year limited warranty on materials and workmanship and include a provision for replacement caused by vandalism.

2.4 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder: Basis-of-Design Product is Bobrick B-224 x 36.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Specialties, Inc.
      b. Bobrick Washroom Equipment, Inc.
      c. Bradley Corporation.
      d. Or equal.
   2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
   3. Length: 36 inches.
   5. Mop/Broom Holders: Four spring-loaded, rubber hat, cam type.
      a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
      b. Rag Rod: Approximately 1/4-inch-diameter stainless steel.

2.5 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.


F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Construction Manager.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install toilet accessory units following manufacturer's instructions, using fasteners appropriate to substrate and recommended by unit manufacturer. Install units plumb, level, and firmly anchored in locations and at heights indicated.
   1. Use concealed fastenings wherever possible.
   2. Provide anchors, bolts and other necessary anchorages.
   3. Install concealed mounting devices and fasteners fabricated of same material as accessories, or of galvanized steel, as recommended by manufacturer.
   4. Install exposed mounting devices and fasteners finished to match accessories.
   5. Provide theft-resistant fasteners for all accessory mountings.
   6. Fit flanges of accessories snug to wall surfaces. Provide sealant in gaps between 90 degree return flanges and finish wall surface after accessories are installed.
   7. Elements of Sanitary facilities shall be mounted at locations in compliance with CBC Sections 11B-602 through 11B-612.

B. Provide solid wood blocking in wall framing as required to receive wall-attached items. Do not attach into hollow wall areas

C. Provide backing where basic substrate is not sufficient to support accessory without additional material.

D. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.
   1. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:  
      a. 1 ½” between the grab bar and the wall.  
      b. 1 ½” minimum between the grab bar and projecting objects below and at the ends.  
      c. 12” minimum between the grab bar and projecting objects above.

E. Protruding Objects (Towel dispensers, napkin disposals, etc.) shall protrude no more than 4 inches per CBC.

F. Coordinate wiring of electric warm-air dryers and soap dispensers with electrical work and specifications.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION
SECTION 10 44 13
FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.
   B. Section 10 44 16: Fire Extinguishers

1.2 SUMMARY
   A. Section Includes fire-protection cabinets for portable fire extinguishers

1.3 PREINSTALLATION CONFERENCE
   A. Preinstallation Conference: Conduct conference at Project site.
      1. Review methods and procedures related to fire-protection cabinets including, but not
         limited to schedules and coordination requirements.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel
      style. Include roughing-in dimensions and details showing recessed-mounting method and
      relationships of box and trim to surrounding construction.
   B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and
      attachments to other work.
   C. Product Schedule: For fire-protection cabinets. Coordinate final fire-protection cabinet schedule
      with fire-extinguisher schedule to ensure proper fit and function. Use same designations
      indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.6 COORDINATION
   A. Coordinate size of fire-protection cabinets to ensure that type and capacity of required fire
      extinguishers indicated are accommodated.
   B. Coordinate sizes and locations of fire-protection cabinets with wall depths. Refer to Drawings to
      verify depth of wall assembly at location of fire-protection cabinets.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in
      ASTM E 814 for fire-resistance rating of walls where they are installed.
   B. Fire Extinguisher Cabinets must comply with CBC Sections 11B-307, 11B-308, 11B-309 and
      11B-403.
2.2 FIRE-PROTECTION CABINETS

A. Cabinet Type: Suitable for fire extinguishers.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Larsen’s Manufacturing Company; “Architectural Series” or a comparable product by one of the following:
      a. American Specialties, Inc.
      b. Guardian Fire Equipment, Inc.
      c. JL Industries, Inc.; a division of the Activar Construction Products Group.
      d. Nystrom, Inc.
      e. Potter Roemer LLC.

B. Cabinet Construction: Nonrated or 1-hour fire rated, depending on wall type.
   1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Cold-rolled steel sheet.

D. Recessed Cabinet: Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Cabinet Trim Material: Stainless-steel sheet.


G. Door Style: Vertical Duo panel with frame.

H. Door Glazing: Clear acrylic sheet.

I. Door Hardware: Manufacturer’s standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Non-locking.
   1. Provide projecting stainless steel door pull and friction latch.
   2. Provide concealed hinge permitting door to open 180 degrees.

J. Accessories:
   1. Mounting Bracket: Manufacturer’s standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

K. Materials:
   1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
      a. Finish: Factory-applied baked enamel or powder coat.
      b. Color: Red.
   2. Stainless Steel: ASTM A 666, Type 304.
      a. Finish: No. 4 directional satin finish.
   3. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer’s standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Provide factory-drilled mounting holes.
B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Fabricate door frames of one-piece construction with edges flanged.
   3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth. Trim material to be same as door material.

2.4 GENERAL FINISH REQUIREMENTS


B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
   1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

B. Related Requirements:
   1. Section 10 44 13 "Fire Extinguisher Cabinets"

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
      a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
1.7 COORDINATION
   A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.8 WARRANTY
   A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.

   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers” and California Code of Regulations (CCR) Title 19- Public Safety.

   B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS
   A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated on Drawings.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amerex Corporation.
      b. Ansul Incorporated; Tyco International.
      c. Potter Roemer LLC.
      d. Or Equal.

   2. Valves: Manufacturer's standard.

   3. Handles and Levers: Manufacturer's standard.

   4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

   5. Finish: Baked polyester powder coat, red color.

   B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated, with monoammonium phosphate-based dry chemical in enameled-steel container. Equip each unit with a pressure gage. Provide the following sizes, located in fire extinguisher cabinets and elsewhere located on Drawings:

   1. 2-A:10-B:C, 5-lb.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mount Fire Extinguishers to provide handle height at a maximum of 48" above finish floor, and the bottom of the fire extinguisher is at a maximum of 27" above finish floor.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION
SECTION 10 51 23
PHENOLIC LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Lockers of the following types: Phenolic core with plastic laminate facing and integral locks and prefabricated metal base.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 0610 00 - Rough Carpentry: Furring, blocking, and shims.

1.3 REFERENCES

Comply with the following:

A. ADAAG - American with Disabilities Act, Accessibility Guidelines.


C. ASTM International (ASTM):
   1. ASTM A 1008 - Standard Specification for Steel Sheet, Carbon, Cold-Rolled, Commercial Quality.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Provide layout and elevations of lockers with overall dimensions.

D. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms.

F. Verification Samples: For finish product specified, two samples, minimum size 6 inches square, representing actual product and color selected.
G. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 QUALITY ASSURANCE
A. Provide all lockers from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Inspect lockers upon receipt for visible damage. Further inspection if necessary for hidden damage.
B. Store products in manufacturer’s unopened packaging until ready for installation.
C. Sequence deliveries to avoid project delays, but minimize on-site storage.
D. Deliver master and control keys to Owner’s Project Representative.

1.7 SITE CONDITIONS
A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.8 WARRANTY
A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures.
   2. Faulty operation of locks or hardware
   3. Deterioration of wood, finishes, and other materials beyond normal use.
   4. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. Basis-of-Design Manufacturer: ASI Storage Solutions, which is located at: 900 Clary Connector; Eastanollee, GA 30538; Tel: 706-827-2720; Email:request info (info@asi-storage.com); Web:http://asi-storage.com
B. Subject to specified requirements, alternate Manufacturers offering comparable products may include, but are not limited to:
   1. Hollman Lockers
   2. Spectrum Lockers
   3. Art Metal Products, Inc.
   4. Or approved equal.
2.2 MATERIALS

A. Plastic: Plastic laminate-faced phenolic core.
   1. Coat Hooks: Zinc plated forged steel; ball ends.
   2. Fasteners: Zinc plated manufacturer's standard.

2.3 PHENOLIC LOCKERS

A. Standard Duty Laminate-Faced Solid Phenolic Lockers:
   1. Acceptable Manufacturer: ASI Storage Solutions
   2. Series: Traditional Series by ASI.
   3. Type of Lockers:
      a. Triple Tier:
         1) Height: 72 inches (1829 mm).
         2) Size: 12 inches (305 mm) wide by 12 inches (305 mm) deep.
      b. Six Tier:
         1) Height: 72 inches (1829 mm).
         2) Size: 12 inches (305 mm) wide by 12 inches (305 mm) deep.

B. Construction:
   1. Components: Solid phenolic core decorative plastic laminate with multiple resin-impregnated kraft and surface sheets fused at high temperature and pressure. Units fabricated using stainless steel fasteners. Exposed edges shall be smooth and chamfered.
      a. Doors shall be constructed of 1/2 inch (13 mm) plastic laminate faced solid phenolic core. Doors shall be fitted with a flush handle, number plate, and combination lock. Door latches shall be mounted at the mid-point of each door. Handles shall be capable of release from the inside of the locker. Perimeter ventilation. Doors shall be mounted to Side Panel using Piano Type hinge and Steel Fasteners. Door edges shall be smooth and chamfered with corners radiused.
      b. End Cover Panels shall be constructed of 1/2 inch (13 mm) solid phenolic core with plastic laminate. Color as scheduled.
      c. Side Panels shall be constructed of 3/8 inch (9.5 mm) solid phenolic core plastic laminate.
      d. Tops, Bottoms and Shelves shall be constructed of 1/2 inch (13 mm) solid phenolic core with Speckle-tone material plastic laminate.
      e. Slope Tops, Filler Panels and Recessed Locker Trim shall be constructed of 1/2 inch (13 mm) solid phenolic core with plastic laminate facing. Provide on all lockers. Color as scheduled to match locker face.
   2. Hinges: Segmented 120 Degree, piano style hinge.
   3. Interior Equipment:
      a. Triple Tier lockers shall have two wall hooks for 12 inches (305 mm) wide lockers. Manufacturer's standard, ball-pointed aluminum or steel hooks. Attach hooks with at least two fasteners. Hooks and number plates will be mounted with rivets.
   4. Color: As selected by Architect from locker manufacturer's full range of solid colors.
   5. Mounting: 4 inches (102 mm) base mounting.
   6. Slope Tops: Continuous slope top shall be 18 gage sheet steel, powder coated to match the color of the lockers. Hoods are 72 inches in length by depth of locker. For longer lengths, slip joints without visible fasteners at splices shall be provided. Provide with end closures. The slope shall rise equal to 1/3 locker depth, plus a 1 inch vertical rise at the front.
   7. Metal Zee Base: Zee bases shall be 14 gauge sheet steel by locker manufacturer, powder coated to match the color of the lockers.

C. Key Locks: Cylinder Lock: Built-in, flush, cam lock with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and four master keys.
   1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.
D. Number Identification Plates: 1-1/2-inch-diameter, etched, embossed, or stamped, aluminum or plastic plates with black numbers and letters at least 1/2 inch high. Identify lockers in sequence indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates and bases have been properly prepared.
B. Notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install lockers and accessories at locations shown in accordance with manufacturer's instructions and reviewed submittals. Condition lockers to average prevailing humidity conditions in installation areas before installation.
B. Install lockers level and plumb with flush surfaces and rigid attachment to anchoring surfaces.
C. Anchor lockers to floor and wall at 48 inches (1.219 m) or less, as recommended by the manufacturer, and in compliance with DSA requirements.
D. Fasten adjoining locker units together to provide rigid installation. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.
E. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
F. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.
G. No evidence of cutting, drilling and/or patching shall be visible on the finished work.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and latches to operate without binding. Verify that latches are operating satisfactorily.
B. Touch-up factory-finish and repair or replace damaged products before Substantial Completion. Use only materials and procedures recommended or furnished by locker manufacturer.

3.4 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

Miscellaneous Specialties specified:

A. “Knox-Box” Emergency Key Storage Box
B. Stainless Steel Corner Guards
C. Bicycle Racks

1.3 SHOP DRAWINGS AND PRODUCT DATA

A. Submit scaled shop drawings and manufacturer's product data sheets covering parts of each item in accordance with Section 01 33 00. Indicate pertinent dimensioning, layout, anchorage and installation requirements. Submit possible color selections where an option.

1.3 PROTECTION

A. Protect items which may cause interference with work of others following their installation until all work is completed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide products specified in the schedule of items in Part 3, complete in respect to function as intended.

B. Fasteners, Screws and Bolts: Type and size recommended by specialties manufacturer for component and substrate. Use non-corrosive (stainless steel or hot-dip galvanized) fasteners on exterior.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items specified with experienced personnel in strict compliance with drawings, reviewed submittals, these specifications, and the various manufacturer's published installation instructions. In every case, the most stringent requirements for installation shall govern this work.

B. Before starting work notify Architect of any conflicts detrimental to installation or operation of items.

C. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
D. Anchorage: Provide anchorage devices required to install the item and its appurtenances, complete. Provide anchorage and rough-in frames in ample time when required to be built in by other trades.

3.2 SCHEDULE OF ITEMS

A. The manufacturers listed below set the function and standard of quality for materials in this Section. Other substitute manufacturers conforming to these standards may be submitted in accordance with Section 01 25 13 “Product Options and Substitutions.”

3.3 BICYCLE RACKS


B. Rack: The Varsity Bike Dock; DV215.
   1. Steel locking loops, wheel pockets, PC/ABS injection molded cap.
   2. Finish: Hot-dipped galvanized
   3. Mounting: Surface mount to concrete with manufacturer’s wedge anchors (WA-215 or equal).

3.4 "KNOX-BOX" EXTERIOR KEY STORAGE BOX

A. Basis-of-Design: Knox-Box recessed-mounted and surface-mounted units with hinged door and face flange, with UL listed tamper switches. 1/4" plate steel housing, 1/2" thick steel door with interior gasket seal and stainless steel door hinge. Box and lock to be UL listed. Lock has 1/8" thick stainless steel dust cover with tamper seal mounting capability. No substitutions.
   1. Manufacturer: Knox Company, Tel. 800-552-5669. www.knoxbox.com
   2. Provide Surface-Mounted Boxes for the gates per Drawings.
   3. Provide Recessed Mounting Kit (RMK) for installation in building wall.
   4. Model 3200: Exterior Rough-in Dimensions for Recessed Mounting Kit: 6-1/2"H x 6-1/2"W x 5"D.
   7. Provide Knox Tamper Alert that connects to building’s alarm system, for the box on the building.

3.5 CORNER GUARDS (CG1)

A. Basis-of-Design: C/S Acrovyn Model 40AB, or approved equal. www.c-sgroup.com
   1. 1.6mm thick stainless steel corner guards. Slightly cranked edges to provide 1.5mm (approx) void behind corner guards to accommodate wall irregularities. Finish: #4 satin.
   2. 40 mm legs (1-9/16 inches).
   3. Provide in full lengths required; do not piece together or splice.
   4. Attachment: Heavy-duty construction adhesive, or stainless steel flathead screws in factory pre-drilled holes.

B. Locations: As indicated on Drawings and as further directed by Architect.

END OF SECTION
SECTION 12 24 13
ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Manually operated, roll-up fabric interior window shades including mounting and operating hardware.
B. Motorized, roll-up fabric interior window shades including motor operator, controls, and mounting hardware.

1.2 RELATED SECTIONS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 061000 - Rough Carpentry: Blocking for support of window shade hardware.
C. Section 079200 - Joint Sealers: Sealants for perimeter of shade system.
D. Section 092900 - Gypsum Board
E. Section 095113 - Acoustical Ceilings: Suspended acoustical panel ceilings to contain recessed window shade pockets.
F. Division 26 - Electrical: Electrical supply, conduit, switches and wiring for motorized window shades.

1.3 REFERENCES
A. NFPA 70 - National Electrical Code.
C. GREENGUARD Environmental Institute Gold.

1.4 SUBMITTALS
A. Submit under provisions of Section 013300 - Submittal Procedures:
B. Product Data: Manufacturer's data sheets on each product specified, including:
   1. Preparation instructions and recommendations.
   2. Installation and maintenance instructions.
   3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
   4. Storage and handling requirements and recommendations.
   5. Mounting details and installation methods.
   6. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.
C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
D. Sustainable Design (LEED) Submittals: Refer to Section 018113. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and
Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:

1. Environmental Product Declaration: For each product.
2. Multi-Attribute Optimization declarations: for each product.
3. Raw Material Source and Extraction Reports: for each product.
4. Leadership Extraction Practices reports or certifications: for each product.
5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.

E. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.

F. Verification Samples: For each finish product specified, two complete sets of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.

G. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

H. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.

B. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use.

C. Mock-Up: Provide a mock-up of one of each type roller shade assembly specified for evaluation of mounting, appearance and accessories.
   1. Locate mock-up in windows designated by Architect.
   2. Do not proceed with remaining work until mock-up is accepted by Architect.
   3. Approved mock-ups may be kept in the finish Work. Remove and re-do unapproved mock-ups.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.

B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.

C. Label containers and shades according to Window Shade Schedule.

D. Store products in manufacturer's unopened packaging until ready for installation.

1.7 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS
A. Install roller shades after finish work and ambient temperature, humidity and ventilation
conditions are maintained at levels recommended for project upon completion.

1.9 WARRANTY

A. Hardware and Shade Fabric: Manufacturer’s standard twenty-five year limited warranty, or
approved equal.

B. Motors and Controls: Manufacturer’s standard five year limited warranty, or approved equal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Draper, Inc., Spiceland, IN 47385-0425. Toll Free Tel: 800-
238-7999; Local Representative: Kathy Greenway Tel: 714 396 9732; Web: www.draperinc.com.

B. Subject to conformance with specified requirements, other manufacturers offering
comparable products may include, but are not limited to:

1. Mechoshade
2. Graber
3. Hunter Douglas
4. Or approved equal.

2.2 MANUALLY OPERATED WINDOW SHADES

A. Manually Operated Window Shades with Independent Control: Manually operated, vertical
roll-up, fabric window shade with components necessary for complete installation; Manual
FlexShade XD as manufactured by Draper, Inc.

1. Operation: Bead chain and clutch operating mechanism allowing shade to stop when
chain is released. Designed never to need adjustment or lubrication. Provide limit
stops to prevent shade from being raised or lowered too far.
   a. Clutch mechanism: Fabricated from POM thermoplastic with welded 0.354 inch
(9 mm) primary steel post with rotational bearing, overrunning design, and
positive mechanical engagement of drive mechanism to tube. White or Black
color as selected by Architect. Center bead chain placement for right or left
hand operation and accommodates side channel with no adjustment of chain
location.
   b. Bead Chain Hold Down: Spring-Loaded Tensioner.

2. Rollers: Extruded aluminum roller tube of appropriate diameter to support shade fabric
with minimal deflection.
   a. Minimum Roller Tube Diameter: 1.56 inches (40 mm).
   b. Fabric Connection to Roller Tube: Spline fabric/roller attachment system to
allow shade fabric to be removed from roller without having to remove roller
from brackets.
   c. Fabric Length: 6 inches (152 mm) greater than window height minimum.
   d. Bottom Slat: 13/16 inch (20.6 mm) aluminum dowel, encased in bottom hem
with heat sealed ends.
   e. Orientation: Regular from back of roller.

3. Mounting:
   a. Endcaps and fascia.

4. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall,
and jamb. Provide size compatible with roller size.
   a. Endcap covers: To match fascia or headbox color.
   b. Mounted to ceiling.

5. Fascia: L-shaped aluminum extrusion to conceal shade roller and hardware.
   a. Attachment: Snaps onto endcaps without requiring exposed fasteners of any
kind. Fascia can be mounted continuously across two or more shade bands. No
notching is required.
b. Shape: Square Fascia Panel.
c. Ceiling mounted
d. Fascia color to be determined by architect

2.3 MOTORIZED WINDOW SHADES – DUAL MOTORIZED – CONFERENCE ROOMS

A. Shade Motor and Control System
      a. Individual Control, Group Control :
         1) Four channel wireless handheld transmitter-White.
         2) Four control wireless wall switch – white
   2. Fascia: Dual Fascia Square to conceal shade rollers and hardware.
      a. Snap on endcaps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands.
      b. Conference room curved – miter fascia to create clean installation

B. Roller: Fabricated from extruded aluminum or steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade size. Provide with roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin to allow easy installation and removal of roller. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.

C. Shade Slat: Slat encased in heat-seamed hem.

2.4 FABRIC

A. Light-Filtering Fabrics

B. Room Darkening Fabrics

C. Color and Pattern: Refer to Finish Specifications on Interiors Drawings.
   1. Mesh fabric 3% - PW4500-P10 Granite
   2. Opaque Fabric SB9110 Gray/White

2.5 OTHER MATERIALS

A. Provide other materials and components, not specifically described but as required for a complete and proper installation, as selected by the Contractor subject to approval of the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
3.2 PREPARATION
   A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.
   B. Coordinate requirements for power supply conduit, and wiring required for window shade motors and controls.

3.3 INSTALLATION
   A. Install in accordance with manufacturer's instructions and approved submittals and mockup.
   B. Electrical Connections: Connect motor-operated roller shades to building electrical system.
   C. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
   D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
      1. Fascias.
   E. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 TESTING AND DEMONSTRATION
   A. Test motorized window shades to verify that controls, limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.
   B. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.
      1. Chain and clutch.
   C. Demonstrate operation of shades to Owner's designated representatives.

3.5 PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 SCHEDULES
   A. Refer to Drawings for shade types and locations.

END OF SECTION
SECTION 12 36 61
QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary
   Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Quartz agglomerate countertops, backsplashes, end splashes, and window sill material
      as indicated on Drawings.

B. Related Requirements:
   1. Section 06 41 16: Plastic-Laminate-Faced Architectural Cabinets
   2. Division 22 “Plumbing Fixtures” for sinks and plumbing fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles,
   methods of joining, and cutouts for plumbing fixtures.
   1. Show locations and details of joints.
   2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:
   1. Countertop material, 4 inches square minimum of each type scheduled.

D. Sustainable Design (LEED) Submittals: For products intending to count towards LEED Materials
   & Resources credits for Building Product Disclosure and Optimization credits for Environmental
   Product, Sourcing of Raw Materials, and Material Ingredients, submit:
   1. Environmental Product Declaration: For each product.
   2. Multi-Attribute Optimization declarations: for each product.
   3. Raw Material Source and Extraction Reports: for each product.
   4. Leadership Extraction Practices reports or certifications: for each product.
   5. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health
      Product Declaration), and/or Material Ingredient Optimization certifications, and/or
      Product Manufacturer Supply Chain Optimization certifications: for each product.

E. VOC Content Reports for Adhesives and Sealants: Documentation indicating the VOC content
   complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Adhesives and
   Sealants.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator or supplier.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals.
   Include Product Data for care products used or recommended by Installer and names,
   addresses, and telephone numbers of local sources for products.
1.6 QUALITY ASSURANCE
   A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
   B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS
   A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION
   A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.9 WARRANTY
   A. Commercial: Provide manufacturer’s Limited Commercial Lifetime Warranty against product defects when fabricated and installed by a manufacturer-certified fabricator.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS
   A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
      1. Basis-of-Design Manufacturer and Color: As indicated on Interior Design Finish Schedule. Verify that Owner and Architect have approved manufacturer, style, texture and color of each countertop type prior to purchasing.
      2. Slab Product: 3/4 inch thick. Backsplash to be 1/2 inch thick 12” x 24” tiles ripped to 6” x 24” to create backsplash stock.
   B. Composite Wood Products (underlayment): Products shall be made without urea formaldehyde.
   C. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Public Health’s "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   D. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
   E. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch-sanded.

2.2 COUNTERTOP FABRICATION
   A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
      1. Grade: Custom.
   B. Configuration: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.
      1. Front: Straight, slightly eased at top, as detailed on Drawings.
      2. Backsplash: Straight, slightly eased at edges and corners.
      4. Edges and Outside Corners: Slightly eased.
   C. Countertops: 3/4-inch- thick, quartz agglomerate with front edge built up with same material.
D. Backsplashes: 1/2 inch thick quartz agglomerate 12" x 24" tiles ripped to 6" x 24" to create backsplash stock.

E. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

F. Joints: Fabricate countertops without joints, or if not possible, then minimum number of joints.
   1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
   2. Joint Type: Matching color Silicone Sealant filled, 1/16 inch in width.
   3. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

G. Cutouts and Holes:
   1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
      a. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
   3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.
   1. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 "Adhesives Material Application Operations."

B. Silicone Mold-Resistant Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops/backsplashes, and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
   1. Install metal splines in kerfs in countertop edges at joints where indicated on shop drawings. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
   2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

J. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated.

END OF SECTION
SECTION 12 48 13

ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and General Provisions of the Contract, including General and Special or Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
   B. Related Section: Section 32 13 13- Concrete Paving

1.02 SUMMARY
   A. This section includes the following types of Flooring Systems:
      1. Entrance Matting and Framing Assemblies for Exterior Use

1.02 REFERENCES
   A. American Society for Testing and Materials (ASTM) B. National Fire Protection Agency (NFPA)
   B. The Aluminum Association, Inc.
   C. The National Floor Safety Institute (NFSI)
   D. ADA Accessibility Guidelines (CFR Part 36 Appendix A)
   E. Surface Flammability of Carpets and Rugs (CFR 16 Part 1630 and 1631)

1.03 SUBMITTALS
   A. Submit the following in accordance with specification section 01 33 00 and contract requirements.
   B. Product data for each type of entrance matting and frame to include:
      1. Product detail drawing including product cross-section and technical information.
      2. Manufacturer’s product specification, installation instructions.
      3. Manufacturer's maintenance and cleaning instructions.
      4. Shop drawings showing traffic direction, dimensions, sectioning, insert types and colors, metal finishes and framing.
   C. Product samples representing the assembled matting with the selected insert and insert color selector, and frame assembly including installation accessories.

1.04 QUALITY ASSURANCE
   A. Flammability: Critical radiant flux 0.45 watts/m² or greater, in accordance with ASTM E648. Life Safety Code® NFPA 101, Class 1 Interior Floor Finish Testing and Classification.
   B. Slip Resistance: Coefficient of friction 0.60 or greater, in accordance with ASTM D2047 tested in wet conditions.
   C. Rolling Load: No deformation with 350 lb/wheel and minimum of 2500 passes. Load applied to a 5” diameter, 2” wide solid polyurethane wheel.
   D. Single Source: Obtain entrance matting and frames from a single source to ensure dimensional compatibility.

1.05 DELIVERY, STORAGE AND HANDLING
   A. Deliver materials in unopened original factory packaging, labeled to identify product and manufacturer. Store in controlled environment. To avoid damage do not stack other material on top of matting or frames.
1.06 PROJECT CONDITIONS

A. Coordinate installation of recess frame with concrete construction. Install frames to ensure dimensions provided in shop drawings are maintained. Finished recess must be flat and level. Defer frame installation until related interior finish work is in progress.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Architectural Products Division of Pawling Corporation, Wassaic, NY 12592. Other manufacturers must comply with requirements indicated in this specification, products data, and shop drawings.

B. Subject to conformance with specified requirements, other manufacturers offering comparable products may include, but are not limited to:
   1. Balco
   2. C/S Group (Construction Specialties)
   3. Nystrom Inc.
   4. Or approved equal

2.02 MATERIALS

A. Aluminum: ASTM B221, alloy 6105-T5 and 6063-T5 for extrusions.
B. Architectural Bronze: ASTM B455, alloy 385 for extrusions.
C. Rigid Vinyl: High impact, rigid PVC.
D. Flexible Vinyl: 80 Durometer, flexible PVC.
E. Tread Inserts: Refer to section 2.03.

2.03 ENTRANCE MATTING

A. Basis-of-Design: Pawling Corporation model EM-650 “Rol-Dek” Entrance Matting. Manufactured from aluminum alloy tread-rail extrusions spaced at 1 7/8” centers, connected by continuous rigid vinyl hinges perforated to provide drainage. Tread rails to include continuous flexible vinyl cushion for contact with substrate and tread rail insert for exposed walking surface. Tread rails are standard in mill finish aluminum.

B. Tread Inserts: Abrasive Aluminum “AA”: Alloy 6105-T5 extruded aluminum with applied medium grit abrasive for maximum slip resistance. Aluminum is mill finish with abrasive available in manufacturer’s standard colors, as selected by Architect.

C. Angle Frame: Model SSF-125, alloy 6105-T5 extruded aluminum angle frame. Installed frame provides 1/8” exposed perimeter trim and a 7/16” deep recess. Finish: Clear anodized aluminum #403. Installer to use self-leveling screed to ensure smooth, flat recess.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrate and area where matting is to be installed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install products in accordance with manufacturer’s installation instructions and approved submittals.
B. Recessed opening must be flat, 1/8” in 10’-0”, and free of debris before Matting is installed.
C. Coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.
D. Delay setting mats until construction traffic has ended.

3.03 PROTECTION

A. Protect installed frames from damage by using temporary plywood filler in recess opening. Cover exposed frames with similar materials until construction traffic is minimized. Install matting when project is near substantial completion and no further wheeled traffic or major construction operations will affect matting.

3.04 CLEANING

A. Include matting and recess in a routine cleaning and maintenance program. Regular cleaning will maximize functionality, appearance, and life span of the product. Refer to manufacturer’s cleaning and maintenance instructions for additional information.

END OF SECTION
SECTION 13 42 73
INTEGRATED INTERIOR ASSEMBLIES (MODULAR PARTITION SYSTEM)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Manufactured partition framing assemblies.
   2. Face and center-mounted tiles.
   3. Glass and glazing.
   4. Doors, frames, and door hardware.
   5. Accessories.
   6. Finishes.
   7. Integrated electrical components.
   8. Integrated communication components.

B. Related Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.
   2. Section 096513 “Resilient Base and Accessories” for site-installed wall base.
   3. Division 26 “Electrical” for electrical services other than electrical wiring integrated in this
      section.
   4. Division 27 “Communications” for communications components other than
      communication services and wiring integrated in this section.
   5. Division 06 “Wood” for cabinetry and millwork not specified in this section.
   6. Division 08 “Openings” for doors and windows not specified in this section.
   7. Division 09 “Finishes” for finish materials not specified in this section.
   8. Division 12 “Furnishings” for furnishings not specified in this section.
   9. Division 22 “Plumbing” for plumbing components not specified in this section.
  10. Division 26 “Electrical” for electrical components not specified in this section.
  11. Division 27 “Communications” for communications components not specified in this
      section.
      not specified in this section.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. AAMA 61198 Voluntary Standards for Anodized Architectural Aluminum.

B. American Society of Civil Engineers (ASCE):

C. ASTM International:
   3. ASTM E 90 Method for Laboratory Measurement of Airborne Sound Transmission Lost
      of Building Partitions and Elements.
   4. ASTM E 413 Classification for Rating Sound Insulation.

D. Architectural Woodwork Standards (AWS): a joint effort of US Architectural Woodwork Institute
   (AWI), Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Woodwork
   Institute (WI).
E. National Fire Protection Association (NFPA):

F. Underwriters Laboratories (UL):
   1. UL QQXX - Sections and Units.

G. Integrated Telecommunications Component References:
   1. ANSI/NECA/BICSI-568-2006 -- Standard for Installing Commercial Building Telecommunications Cabling
      a. ANSI/TIA/EIA Standards:
         1) ANSI/TIA/EIA-568-B.1 -- Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
         2) ANSI/TIA/EIA-568-B.2 -- Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components
         3) ANSI/TIA/EIA-568-B.3 -- Optical Fiber Cabling Components Standard
         4) ANSI/TIA/EIA-569-B -- Commercial Building Standard for Telecommunications Pathways and Spaces
         5) ANSI/TIA/EIA-606(A) -- The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
         6) ANSI-J-STD-607(A) -- Commercial Building Grounding and Bonding Requirements for Telecommunications
         7) TIA-526-7 -- OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
         8) TIA-526-14A -- OFSTP-14 Optical Power Loss Measurements of Installed Multi-mode Fiber Cable Plant
         9) TIA-758(A) -- Customer-Owned Outside Plant Telecommunications Cabling Standard
        10) TIA TSB-140 Additional Guidelines for Field Testing Length, Loss And Polarity of Optical Fiber Cabling Systems
      b. BICSI:
         1) BICSI -- Telecommunications Distribution Methods Manual
         2) BICSI – Installation Transport Systems Information Manual
         3) BICSI – Network Design Reference Design Manual

1.3 DEFINITIONS

A. Integrated Prefabricated Interior Construction: A construction process that includes an integrated “design assist” approach to design by using a software that allows for the designing, pricing, engineering and manufacturing of the assemblies and integration of other’s components for a prefabricated construction method for the interior construction of a facility. The entity has the ability to use prefabricated method of construction, i.e. offsite construction, using software for the manufacturing of the assemblies. Through the use of parametric design, framing assemblies have the ability to embed different AV components while also allowing for the integration of the following but not limited to:
   1. Electrical and networking solutions, medical gas, millwork, murphy beds, exam tables.

B. Tiles: Panel-like materials face-mounted on wall framing to provide a finished surface; or center-mounted within a frame to fill and opening. Finishes and material can vary between MDF substrate or Glass.
C. ICE: DIRTT’s proprietary ICE software (“ICE”) allows for an automated manufacturing process which integrates numerous work processes involved in conventional construction including design, sales, ordering, engineering, manufacturing specifications, delivery and installation using a single underlying real-time engineering and manufacturing data set.

D. Mass Customization: ICE allows for individual customization, manufacture and deliver custom DIRTT Solutions to satisfy a specific customer’s needs. Mass customization is a manufacturing technique that combines the flexibility and personalization of custom-made solutions with the low unit costs associated with mass production.

E. Customer’s Own Materials (COM): Owner (customer) or Distribution Partner furnished materials or components provided to manufacturer for factory application or installation. Items provided in accordance with production schedule indicated in the Shop Drawings.

F. Distribution Partner: Qualified entities that partner with DIRTT Environmental Solutions throughout North America and whom provide design assist using the ICE software. DIRTT Distribution partners act as the subcontractor and hold all contractual agreements. Local Distribution Partners are used for projects. The Distribution will be responsible to procure all material, certified labor and cover all costs for the project scope along with all design and site coordination with other trades.

1.4 COORDINATION

A. Comply with Division 01 project management and procedures.

B. Project Scheduling and Lead Times: Manufacturing production time of all standard solutions and finishes shall not exceed 6 weeks, inclusive of shipping within US and Canada, from manufacturers receipt of complete order information (including shop drawing approval, deposit cost, and notice to proceed).

1. Maximum delivery time on solutions included on GSA contracts shall not exceed 45 days. Coordinate adjacent work, including other work by others to be installed within or next to Work of this section.

C. Project Scheduling and Lead Times: Manufacturing production time of all standard solutions and finishes for International projects, inclusive of International shipping, to be confirmed by Construction Schedule.

D. Schedule: Coordinate delivery with construction schedule to avoid storage or double handling of the integrated prefabricated interior construction partition assemblies and solutions.

E. Install integrated prefabricated interior construction partition assemblies and solutions after the building is enclosed and conditioned including completion of HVAC equipment, fire suppression system, lighting, adjacent ceilings and base building finishes in a sequence that allows final electrical connection, voice data/communications to be completed during or after installation of the partition systems.

1. Coordinate integrated prefabricated interior construction partition assembly installation with ceiling, floor finish, and specified wall base (partition framing standard base, applied base, or integral base installation).

F. Floor and base finishes may be completed before installation of integrated interior partition system framing unless coordinated with the manufacturer ahead of time through the Shop Drawing process.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site a minimum of one week prior to Shop Drawing approval and prior to beginning installation.

1. Meeting participants include authorized representatives of the Owner, Architect, base building contractor, and all trades whose work will interface with installed systems.
1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for integrated prefabricated interior partitions and integrated components.
   2. Provide product data sheets for all types of Hardware and Accessories.
   3. Provide product data sheets for equipment to be installed or connected by others.

B. Sustainable Design Submittals:
   1. For products intending to count towards LEED Materials & Resources credits for Building Product Disclosure and Optimization credits for Environmental Product, Sourcing of Raw Materials, and Material Ingredients, submit:
      a. Environmental Product Declaration: for each product.
      b. Multi-Attribute Optimization declarations: for each product.
      c. Raw Material Source and Extraction Reports: for each product.
      d. Leadership Extraction Practices reports or certifications: for each product.
      e. Two of the following: Material Ingredient Reporting (Manufacturer Inventory or Health Product Declaration), and/or Material Ingredient Optimization certifications, and/or Product Manufacturer Supply Chain Optimization certifications: for each product.
   2. VOC Content Reports for Architectural Coatings: Documentation indicating the VOC content complies with the limits set forth in Section 01 81 13 for Low Emitting Materials, Paints and Coatings.
   3. Laboratory Test Reports: Architectural Coatings: For clear wood finishes, primers, and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego air Pollution Control District Rule 67.0.1 “Architectural Coatings.”

C. Shop Drawings:
   1. Provide structural analysis data and calculations for installed products to demonstrate compliance with design loads, signed and sealed by licensed professional engineer registered in the jurisdiction of the project.
      a. Include engineering calculations for grid connections, bulkhead connections, and seismic conditions.
   2. Provide manufacturer’s architectural plans, elevations, sections, connection and attachment details, finish schedule, reflected ceiling plans, doors and hardware schedule, electrical and mechanical requirements, schedules, and locations.
      a. For integrated millwork, include plans, elevations, sections, component profiles, connection and attachment details, and finish schedule.
      b. For integrated electrical components:
         1) Indicate device type and location on Shop Drawing plans and elevations to confirm accurate scope of work has been captured from engineering plans or client. Coordinate as required until scope is confirmed by all affected parties.
         2) Provide adequate legends to confirm electrical device specifications, amperage, trim ring and faceplate colors and styles, cable type, device type, and applicable level.
   3. Provide manufacturer with product data, fabrication drawings, schematics and similar information for mechanical and medical gas components to be embedded within or supported by partitions.
   4. Provide manufacturer with product data, fabrication drawings, schematics and similar information for data, security, or communications to be embedded within or supported by partitions.
   5. Include field measurements of existing construction, future construction, finished width and height of partitions and associated components.
      a. Manufacturer’s authorized representative shall undertake field measurements to show relevant adjacencies in Shop Drawings. Site conditions, base building construction, and required clearances are to be reviewed and approved by the
Architect, including exiting, life safety, location of building service devices, and other affected trades through Shop Drawings to identify and prevent potential conflicts.

b. Where field measurements are not possible, hold-to and control dimensions must be coordinated and agreed upon by all parties through the Shop Drawing process before manufacturing begins.

D. Integrated Millwork Schedule:
1. Provide a schedule with finishes organized by installation area, room, or project delivery package using designations on the Drawings.
2. Final quantities, types and locations may be reviewed by others in addition to the Architect to confirm all necessary components and accessories are included, note special coordination or concerns on the schedule as required.

E. Samples: Provide manufactures standard size samples for verification of support system and each type, color, and texture of exposed finish, full thickness and the following minimum sizes:
1. Extrusion Components.
2. Tile Finishes.
3. Linear Trim and Base.
4. Door Face Finishes.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:
1. Provide shop drawings for coordination between trades upon request.
2. Provide architectural plans locating integrated interior partitions within the base building, including finishes and construction of surfaces the partition system will interface with or connect to.
3. Provide reflected ceiling plans, drawn to scale, to show penetrations and ceiling mounted items to be coordinated with partitions and associated system components.
4. Structural: coordinate structural connections to base building and generate engineering calculations where required by the local building authority.
5. Plumbing and Piping: Coordinate plumbing components with final plumbing engineering documents.

B. Qualification Data: For Installer and manufacturer.

C. Product Test Reports, Solid Partitions: Based on evaluation of comprehensive tests performed by a independent qualified testing agency:

D. Evaluation/Certification Reports:
2. UL QQXX - Sections and Units for electrical components.
3. OSHPD Preapproval of Manufacturers Certification (OPM-0044-13).
4. CCRR 1012 – Code Compliance Research Report for Solid Wall / Tile Faced Wall.
5. Flame Spread Reports for finishes (ASTM E84 or CAN |ULC S102) provide relevant testing reports for finish type specified on the project.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For manufacturer's special warranty.
1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Provide maintenance data for incorporation into operation and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall specialize in designing and manufacturing integrated interior construction systems of the quality and complexity required for this project with a minimum of 10 years documented successful experience. Manufacturer shall have production facilities capable of meeting contract requirements for single-source responsibilities and warranty.

B. Installer Qualifications: An entity that contracts with an authorized representative who is trained and certified by manufacturer for installation.

C. Certifications:
   1. Sound Transmission Characteristics: Testing to be performed by a qualified independent testing agency in accordance with performance requirements.

D. Integrated Electrical Components:
   1. Factory Installed Electrical Components, Devices, and Accessories:
      a. Factory Inspections to support UL, Intertek (ETL), and other specified listings by independent accredited 3rd Party Agency.
   2. Field Installed Electrical Components, Devices, and Accessories:
      a. Connections to the base building electrical system and all field installed electrical components, devices, and accessories shall be performed by an electrical contractor licensed in the jurisdiction of the project in accordance with applicable building / electrical codes and standards.
      b. Such work shall be performed under permit, tested, and inspected to confirm adequacy of final installations and connections to the satisfaction of the Authority Having Jurisdiction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver or install integrated interior construction system partitions until spaces are enclosed and weather-tight, wet work is complete and dry, work above ceilings is substantially complete, and HVAC system is operational and able to maintain ambient temperature and humidity conditions at occupancy levels for the remainder of the construction period.

B. Ship system components in manufacturers standard packaging. Maintain air circulation during shipment. Do not allow packaging to get wet or develop condensation.

C. Deliver materials to project site or offsite warehouse as directed by the Contractor or Owner as applicable, and in accordance with the manufacturer’s instructions in original unopened and undamaged packages. All elements and components shall be labeled with manufacturers name, brand names, size, finishes, and placement locations to be coherent with drawings.

D. Store in a clean, dry, secure space to protect from damage during construction activities. Minimize or eliminate storage period by coordinating with construction schedule.

E. Handle in accordance with the manufacturer’s instructions.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install system and components until building is enclosed and finishing operations are complete
B. Temperature and humidity shall be maintained to final occupancy standards. Installation areas shall be climate controlled between 60 and 90 degrees F (15.5 and 32.2 C) with Relative Humidity maintained between 25 and 55 percent.

1.12 WARRANTY

A. Manufacturer's Standard Limited Warranty: Manufacturer agrees to repair or replace components of integrated prefabricated interior construction systems that fail(s) in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 year(s) limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specified requirements, provide a standard system manufactured by DIRTT Environmental Systems. San Diego Representative: Parron Hall, San Diego, CA. Tel. 858-268-1212. At the current time, only DIRTT Environmental Systems is providing integrated prefabricated interior construction systems as described in this Section.

B. Source Limitations: Obtain manufactured partitions, integrated components, and accessories from single source from single manufacturer.

C. Substitutions are not allowed.

2.2 SYSTEM DESCRIPTION

A. Factory sub-assembled, site installed, integrated prefabricated interior solid and glazed partition assemblies, including structure, face site-mounted or center-mounted finished tiles, metal framing and doors to accept a variety of millwork, finishes, building services components, technology, equipment, and accessories.

B. System is floor-supported, floor-to-ceiling site constructed in configurations shown on the Shop Drawings. Top channels hold partition systems in place and accommodate height adjustments to suit floor-to-ceiling dimensional variations and similar site specific requirements.
   1. Where partition systems are not clipped to ceilings or other overhead construction, additional structural review and system engineering will be required by the manufacturer.

C. Tile Attachment: Unitized aluminum frame assembly to support face mounted tiles in orientation and module increments as shown on the Drawings.

D. Partially Unitized Solid Wall system shall be comprised of components which can be disassembled, relocated / field cut and substantially reused.

E. Face tiled finishes applied to lightweight frame system, may be monolithic or segmented with the ability to span off-module, or across multiple frames in segments or monoliths, vertically and horizontally.

F. Manufacturer shall provide integrated strategy for accommodating accessory channels and reveals integrated into the structural frame allowing universal horizontal alignment to support furniture, storage, equipment and other components without defacing or damaging face tile or structural frame.
   1. Materials manufactured by others shall not exceed the integrated interior construction system manufacturer’s limitations or tested performance.

G. Manufacturer shall provide integrated strategy for internal blocking accommodating support for wall-hung millwork using French cleat installation process.
H. Manufacturer shall provide accommodation / provision for the embedding (fully encased behind glass) of technology in the wall cavity: structural framing shall allow for universal non-standard AV display, sound, and various support equipment to be mounted in the cavity of the wall with all required structural brackets, wire management, access and ventilation equipment to prevent overheating.

I. Manufacturer shall provide ability for independent configuration / finish. Each side of wall must have the capability for variable aesthetic and function to suit different requirements. This will allow for the one side of the wall to have a totally independent function than the other to meet each organizations requirement.

J. Manufacturer shall accommodate and provide provisions for additional embedded elements (ie sofas, beds, exam tables, chaises, charting stations, and millwork) in the wall cavity as documented.
   1. Embedded elements and accessories to be provided by others may require additional engineering for structural framing and supports within partitions. Submit documentation of all items to be mounted to or embedded in the integrated partition assemblies for manufacturer review and approval.
   2. Do not proceed with procurement or fabrication without integrated partition manufacturers review and approval.

K. Electrical and Communications Access: 1 inch (25 mm) to 3 inches (75 mm) clear wall cavity for accessible from either side of partition by removable face tiles.

L. Provide back boxes, supports, and conduit as required to accommodate lighting, signage, data, security and communications indicated on shop drawings. Integrated prefabricated interior partition manufacturer to provide continuous 1 inch (25 mm) open cavity vertically and horizontally within the wall framing.

M. Integrated prefabricated interior construction system manufacture shall allow for adaptability and retrofitting of hardware for future division of partitions, tiles, or supports to the greatest extent practical.

2.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Integrated interior construction system partitions shall be capable of withstanding the effects of gravity loads, dead loads, and the following loads and stresses within limits and under conditions indicated:
   1. Transverse Load: Lateral deflection of the overall span when tested under a uniformly distributed load of 5 psf (0.24 kN/m²) in accordance with ASTM E 72 where L equals partition wall height:
      a. Solid Walls: not more than L/120;
      b. Glass Walls: not more than L/175 or 3/4 inch (19 mm) whichever is more stringent.
   2. Mechanical Strength: Capable of withstanding static loads in accordance with ANSI/BIFMA X5.6.
   3. Seismic Performance: Provide integrated interior construction partitions capable of withstanding effects of seismic motions determined according to the currently adopted building codes.

B. Acoustical Performance: Where STC ratings are indicated, provide partitions with STC rating determined by testing an identical system to ASTM E 90 and classified in accordance with ASTM E 413.
   1. Sound Transmission Coefficient (STC) range shall be determined in accordance with Sound Transmission Test by Two-Room Method and reported in accordance with ASTM E 90 and ASTM E 413 for frequency data. Tested assembly shall have been assembled in the same manner the partitions to be installed on the project.
   2. Test results vary based on glass or solid wall configuration, and implementation of perimeter enhancements at base building connections.
      a. Solid wall results range up to 50 STC performance.
b. Glass wall performance is limited by the glass specified. Coordinate requirements with the integrated partition manufacturer.

C. Fire Resistance:
   1. Surface-Burning Characteristics: Tested in accordance with ASTM E 84 by a qualified independent testing agency. Materials will comply with CBC Table 803.11.

D. VOC Limits
   1. Comply with the requirements of the California Department of Public Health’s “Standard Method for Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers.”
   2. Ultra-Low Formaldehyde: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde resins as described in the California Air Resources Board’s “Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Product” or shall be made with no added formaldehyde.
   3. Adhesive and sealant VOC content shall meet San Diego Air Pollution Control District Rule #67.21 “Adhesives Material Application Operations.”
   4. Architectural coating VOC content shall meet San Diego Air Pollution Control District Rule 367.0.1 “Architectural Coatings.”

2.4 INTEGRATED PREFABRICATED INTERIOR CONSTRUCTION SYSTEM FRAMING

A. Framing for Solid and Face Tiled Partition Assemblies:
   1. Material: Aluminum extrusions, 6063T6 aluminum alloy, thickness engineered to meet performance requirements specified above.
   2. Vertical Support Spacing: 6 inch (150 mm) minimum to 48 inch (1219 mm) maximum.
   3. Ceiling Track: Continuous, with intermittent breaks for pass through of building services or structural components.
   4. Floor Track: Modular with wall frames inclusive of carpet grippers or floor tape (non-seismic) or continuous with floor anchor attachment (seismic) stopped at doorways and pass-throughs.
   5. Bracing: as required to meet structural performance.
   6. Fasteners: Zinc Plated Steel Type F Screws unless otherwise indicated on engineered shop drawings.

B. Framing for Glazed Partitions:
   1. Same as solid tile framing with customized spacing as shown on the Drawings. Maximum spacing 60 inches (1524 mm).

C. Frame Bases:
   1. Provide frame bases with provisions for 1-1/2 inch (38.1 mm) height adjustment to accommodate floor slab variances.
   2. Provide a leveling mechanism for making fine adjustment in height over adjustment range of the product.

2.5 FACE-MOUNTED AND CENTER-MOUNTED FINISH TILES

A. Tile Mounting: Face-mounted and/or Center-mounted as indicated on Drawings.

B. Tile Construction:
   2. Glass Tile: Tempered Glass.
      a. Provide with the following premium options. Coordinate with manufacturer as required, all options may not be able to be combined.
         1) No Added Formaldehyde (NAF).
         2) Forest Stewardship Council (FSC) Certification.
         3) Flame Retardant Type (MDF) where required.
   3. Thickness:
a. Solid Tiles: 1/2 inch (13 mm).
b. Glass Tiles: 1/4 inch (6 mm) with aluminum mounting rails to maintain alignment with adjacent finishes.
4. Widths: As shown on shop drawings.
5. Height: As shown on shop drawings.
6. Finishes: As specified below and as shown on the Drawings.

C. Reveals:
1. Classic: 0.35 inch (9 mm);
2. Enzo: 0.15 inch (4 mm).

2.6 GLASS AND GLAZING
1. Typical: Tempered glass thickness 3/8 inch (10mm) to ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1, Class 1 (transparent), Quality q3. Type GL-5 As shown on shop drawings finish tag M4
2. Back Painted Glass: As specified with finishes below.

2.7 DOORS AND HARDWARE
A. General:
1. Coordinate security system components to be provided by others with partitions manufacturer through the Shop Drawing process.
2. Provide uneven leaf doors as documented on Shop Drawings.

B. Glazed Aluminum Doors: Manufacturer's standard stiles and rail door, butt hinge, sliding operation, glazed aluminum doors.
1. Door Thickness: 1-15/32 inches (43 mm) thick.
2. Stile Width: 6 inches (152 mm).
3. Top Rail Height: 6 inches (152 mm).
4. Bottom Rail Height: 7-7/8 inches (200 mm) sliding or 12 inches (305 mm) swing doors AFF.
a. Provisions for ADA bottom rails as determined by the design professional of record.
5. Adjustability: Provide door skirt to accommodate varying floor levels.
6. Door Height: As noted on shop drawings. Maximum height 10 feet (3 meters).
7. Glazing: 10mm clear tempered glazing, as indicated on drawings as finish tag M4.
8. Hardware Reinforcement: Factory milled by partition manufacturer to suit glass and hardware supplied by others as shown on show drawings.
9. Finish: Clear anodized Aluminum

2.8 DOOR FRAMES
A. Butt Hinge Frames: Manufacturer's standard aluminum frame, factory milled to receive hardware, for 1-11/16 inch (43 mm) [+/- 1/16 inch (1.5 mm)] doors. Door frames capable of reconfiguration without part replacement or damage to wall components.
1. Door Module Size: As scheduled
a. Finished door width is equal to module width less 3 inches (76 mm).
2. Configuration: Header, jambs and pivot hardware. Single door frame width not to exceed 51 inch (1219 mm) wide module.
3. Hardware Reinforcement: milled, reinforce, drill and tap frames at factory to receive specified hardware in accordance with the contract hardware schedule and templates.
4. Frame Height: Jambs over length 50 mm (2 inches), for field cutting to suit opening height for proper alignment with adjacent frames.
5. Frame Preparation: Factory milled frame with hinge locations and sizes as determined and set by manufacturer; including factory installed steel backer plates for four (4) hinges (2 pair):
a. Hinges: 4-1/2 x 4 Stanley BB1409 fastened with 10-24 flat head machine screws.
b. For C.O.M. Doors Conform to partition manufacturer's standard size, hole pattern and fastener type for hinges, levers or pulls to be supplied by others.

6. Electrical Requirements:
   a. Security System Components: Coordinated hardware requirements and prep work for security system components (supplied by others including but not limited to: electronic strikes, Magnetic locks, electrified locksets, hinges, request to exit buttons, motion sensor rex, door position contacts).

7. Factory notched and drilled jambs for ceiling track and manufacturer’s standard header attachment.

8. Extrusion Profile: profile to match any adjacent unitized glass frames.


B. Hardware: As specified "Hardware by DIRTT System”.

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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2.9 EMBEDDED COMPONENTS

A. Plug and Play power chassis

B. Universal Monitor Mounting Bracket.

C. Fan Kits:
   1. Interactive Wall Fan Kit:
   2. Vertical 3-Fan Kit:

2.10 INTEGRATED ELECTRICAL SERVICE

A. Performance Requirements.
   1. Electrical work shall be inspected prior to installation of finishing panels.

B. System Description
   1. System can be provided with electrical and network components mounted at varying heights installed in accordance with Division 26 Electrical and 27 Communications and as indicated.

C. Electrical Components, General
   1. Electrical, Communications, and Security System Requirements: Provide for installation of electrical, communications, and security system items arranged so that wiring can be readily removed and replaced.
      a. Flex Conduit: Provide UL listed per ANSI/UL-1, NEC Type FMC fabricated of lightweight, high-strength aluminum alloy, in locations shown on Shop Drawings.
      b. Refer to Division 26, 27, and 28 Sections for conduit raceway and pull wire requirements.
   2. All electrical installations must be inspected as part of the electrical contractor’s scope prior to installation of face mounted finish tiles.
D. Electrical Components, Level 1

1. Level 1 Conventional Electrical:
   a. Panel cut out and mounting brackets.
   c. Optional frame vertical modification for horizontal frame to frame pass-through. Wall frame verticals on both sides of frame will be modified to provide 2 cutouts and a support bracket for frame to frame power/data pass-through.
   d. Does not include wiring/cabling, conduit, conduit connectors, devices or faceplates. These items are to be supplied and installed by electrical / data contractors and must be coordinated between trades accordingly.
   e. All home runs, connectors and connections are performed by electrical contractor.

2. Level 1 Modular Electrical:
   a. Panel cut out and mounting brackets.
   b. Modular back box: Factory installed.
   c. Modular faceplates: Shipped loose, field installed.
   d. Modular trim rings: Shipped loose, field installed.
   e. Optional frame vertical modification for horizontal frame to frame pass-through. Wall frame verticals on both sides of frame will be modified to provide 2 cutouts and a support bracket for frame to frame power/data pass-through.
   f. Does not include wiring/cabling, conduit, conduit connectors, devices or faceplates. These items are to be supplied and installed by electrical / data contractors and must be coordinated between trades accordingly.
   g. All home runs, connectors and connections are performed by electrical contractor.

E. Electrical Components, Level 2 used at locations for accessories and not DIRT TT provided plug and play power.

1. Level 2 Conventional Electrical:
   a. Panel cut outs.
   b. Conventional back box and mounting brackets (factory installed).
   c. 3/4 inch (21 mm) inside diameter EMT for power or data is fed to the top or bottom of the panel (factory installed). EMT will extend 6 to 8 inches (150 to 200 mm) above finished ceiling (after installation) for ceiling fed power or to the bottom of the frame for floor fed power.
   d. Does not include wiring/cabling, conduit, conduit connectors, devices or faceplates. These items are to be supplied and installed by electrical / data contractors and must be coordinated between trades accordingly.

2. Level 2 Modular Electrical:
   a. Panel cut outs.
   c. Modular back box: Factory installed.
   d. Trim rings: Shipped loose, field installed.
   e. Face plates: Shipped loose, field installed.
   f. 3/4 inch (21 mm) inside diameter EMT for power or data is fed to the top or bottom of the panel (factory installed). EMT will extend 6 to 8 inches (150 to 200 mm) above finished ceiling (after installation) for ceiling fed power or to the bottom of the frame for floor fed power.
   g. Does not include wiring/cabling, conduit, conduit connectors, devices or faceplates. These items are to be supplied and installed by electrical / data contractors and must be coordinated between trades accordingly.

F. Electrical Components, Level 4

1. Level 4 Modular Electrical:
   a. Panel cut outs.
   c. Trim rings: Shipped loose for field installation.
   d. Faceplates: Shipped loose for field installation.
   e. UL listed modular wiring system includes the device, the box assembly, a modular connector, all wiring and terminations.
f. The modular connector attached to the box to be extended above the modular partition to the slab above where it will connect to a splitter.
g. Provide the following from the splitter, to the electrical panel:

   1) Whip Distribution: New or existing junction boxes in the ceiling hardwired by the Electrical Contractor connect to whips with a pigtail on one and modular connector on the other end provided by the prefabricated modular partition manufacturer.

h. Final lengths of power components are project specific and will be determined by the base building plenum height and the specific solution chosen. All power solutions can also run down to a raised floor.
i. Pre-wired device 20 amp: Factory installed.
j. 3/4 inch (21 mm) inside diameter EMT for data to the top or bottom of the panel (factory installed). EMT will extend 6 to 8 inches (150 to 200 mm) above finished ceiling for ceiling fed data or to the bottom of the frame for floor fed data. EMT, when used in concert with a Level 4 electrical solution, is grounded to the electrical back box with a #14 bond wire.
k. All home runs and connections to the modular electrical system is performed electrical contractor by permit.
l. Includes controlled outlets where required by the electrical engineer.

2.11 ASSEMBLY COMPONENTS

A. Connections and Supports: Manufacturer's standard connections and supports that connect and release from floor and ceiling without damage using carpet grippers and ceiling track clips, with exception of the following conditions: bulkhead (drywall ceiling), seismic conditions, electrical or service feeds, physical connections to base building where required.

B. Tile Joint Closure: Manufacturer's standard, capable of closing up to a 1-inch (25 mm) gap between prefabricated partitions and base building elements.

C. Trim: Continuous and modular, factory finished, snap on type; field cuttable for variations in floor and ceiling levels.
   1. Base Trim Profiles: Recessed; removable to access leveling mechanisms.
   2. Ceiling Trim Profile: Recessed; adjustable to accommodate up to a 1/2 inch (13 mm) gap between demountable partitions and base building elements.
   3. Wall Trim Profile: Recessed; adjustable to accommodate up to a 1/2 inch (13 mm) up to 1 inch (25 mm) gap between demountable partitions and base building elements.
   4. Tile to Tile Profile: As detailed.
   5. Colors: As selected by Architect from manufacturer's full range.

D. Brackets:
   1. Manufacturer's brackets, supports and accessories for complete installation of system's furniture components, architectural millwork, audio visual equipment, and paper accessories.
   2. Provide bracket design to enable other system furniture to mount to integrated partitions, on or off module.

2.12 ACCESSORY COMPONENTS

A. Worksurface Support Assembly:
   1. Cantilever Top Offset Bracket:
   2. Sit-Stand Worksurface Bracket:

B. Accessories - Classic:
   1. Chart Rail Shelf
   2. Coat Hook
   3. Picture Hook
   4. Paper Hanger
5. Door Stop Post

2.13 FABRICATION

A. Frames:
   1. Unless otherwise indicated on shop drawings, factory assembled frames with 1 inch (25 mm) insulation, base track and levelers.

B. Face-Mounted and Center-Mounted Tiles
   1. Face-Mounted Tiles: Installed to frames on site.
   2. Center-Mounted Tiles: Factory and Field installed.

C. Glazing:

D. Components:
   1. Fabricate components for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings.
      a. Exceptions: Drywall ceiling, seismic applications and doors against base building require screw holes in base building for proper fastening.
   2. Fabricate for installation with manufacturer’s standard seals at floor and other locations where partition assemblies abut fixed construction and for installation of sound attenuation insulation in partition cavities.

2.14 GENERAL FINISH REQUIREMENTS

A. Protect finishes on exposed surfaces from damage during shipping.

B. Appearance of Finished Work:
   1. Finishes shall match approved samples.
   2. Variations in natural finishes such as stone and wood shall be reviewed and accepted in accordance with industry standards.

C. Frame Finishes:
   1. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I.

D. Factory Applied Tile Finishes: Make joints only where total length exceeds maximum manufactured length. Joints and reveals as indicated on approved Shop Drawings.
   1. Paint Finish (PNT):
      b. Coating Type: UV cured water based paint, Chromacoat or approved equivalent.
      c. Color: per finish schedule.
      d. Paint Match Manufacturer: Sherwin Williams
      e. Paint Match Description: per finish schedule
      f. Paint Match Color number: per finish schedule.

E. Other Tile Finishes
   1. Magnetic Markerboard: Porcelain enamel, balanced, high-pressure laminated, porcelain enamel-faced tiles, of three ply construction consisting of face sheet, core material, and backing.
      a. Porcelain Face Sheet: Prefinished 28 gauge steel adhered to substrate.
      b. Core Material: 1/2 inch (13 mm) thick MDF.

F. Door Finishes:
   1. Clear anodized aluminum; AAMA 611, AAM12C22A31, Class I
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify field or hold-to control dimensions before fabrication of integrated interior construction system partitions. Coordinate fabrication schedule with construction schedule and progress to avoid delay in the work.
   B. Examine all adjoining work including work by others.
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Locations to receive partitions shall be inspected for compliance with manufacturers requirements.
   B. Site floor conditions must be surveyed to determine the nature of floor level and determine where special conditions exist beyond manufacturer’s standard leveling capabilities of 1-1/2 inch in 4 feet (38.1 mm in 1219 mm).
   C. Field conditions and pre-existing installations by others which may adversely affect installation or exceed the manufacturers limitations shall be corrected before installing partitions.

3.3 INSTALLATION
   A. Installation of integrated interior construction system shall be completed by a manufacturer certified installer.
   B. Install system level, plumb, and aligned.
   C. All building services shall be installed and connected to the base building systems by licensed subtrades. All building services shall be inspected by authorized trade representatives and Authority Having Jurisdiction in the presence of a manufacturer representative. Coordinate with all affected parties as required.
   D. Installation sequence as determined by the certified installer and coordinated with the General Contractor based on project conditions.

3.4 MILLWORK INSTALLATION
   A. Install materials and systems in accordance with the integrated prefabricated assembly manufacture’s written instructions or base building documents as applicable.
   B. Install system rigid, level, plumb, with uniform appearance and in proper relationship with adjacent construction maintaining alignments as indicated on the design documents and as directed by the Architect if not shown.
   C. Installation Tolerances:
      1. Plumb and Level: 1/8 inch (3 mm) or tighter in 96 inches (2400 mm).
      2. Install countertops, including L or other shaped counters, with no more than 1/8 inch (3 mm) sag, bow or other variation from a straight line over the entire length.
      3. Scribe Modular Architectural Woodwork and filler panels to ensure a tight fit, leaving no gaps larger than 1/8 inch (3 mm) in the final installation.
   D. Joint Sealing:
      1. Movable Installations: Ensure all currently exposed and future exposed finishes are not damaged, repair or replace as needed to the satisfaction of the Architect.
2. Permanent installations: In addition to verifying finishes, fill all gaps including concealed gaps with silicone or other specified joint sealants.
3. Responsibility for joint sealing is to be coordinated prior to installation or becomes the responsibility of the general contractor.

E. Adjust doors, drawer fronts and cabinet hardware for proper operation.

3.5 INTEGRATED ELECTRICAL COMPONENT INSTALLATION

A. All building services shall be inspected by authorized trade representatives and the local building authority. Refer to Shop Drawings for location of components incorporated into prefabricated partitions.

B. In general, installation locations and dimensions are installed a typical distance from prefabricated partition edges, refer to Shop Drawings for more information.

3.6 CLEANING

A. Upon completion of installation, integrated interior construction system components and finishes shall be cleaned in accordance with the finish manufacturer’s instructions. Alkaline or abrasive agents shall not be used. Avoid scratching or marring finishes.

3.7 PROTECTION

A. Protect from damage through the duration of construction activities.

3.8 DEMONSTRATION

A. Refer to Division 01 Section “Demonstration and Training”.

B. Manufacturer’s Distribution Partner will be responsible to provide general product training to the Owner or their outsourced operations team at time of installation as well as conduct a comprehensive training session(s) to convey the methodology, and assembly of the partitions to sustain general operational maintenance by the Owner’s personnel with clearance over the facilities lifetime.

C. Reconfiguration and modifications shall comply with manufacturer’s warranty requirements. Extensive or unusual changes will require additional Shop Drawings and manufactured components.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not necessarily limited to that shown on the approved plans and requirements of this section.

B. Private site fire water system shall include the following:

1. Connection of new fire service lateral to existing private fire main system.
2. All on-site pipe, fittings, valves, hydrants and appurtenances as shown on the approved plans.
3. Fire department connection as approved by responding fire agency.
4. Building system service entry at each riser room.
5. All tests, flushing, inspections and sanitation treatments as required to obtain approval by all authorities having jurisdiction including local fire authority, serving water department and DSA Inspector of Record.
6. Fees, permits, inspections and tests.
7. Meetings and correspondence with project team members and authorities having jurisdiction to confirm specific requirements for this project, including:
   a. Locations and methods of discharging water from tests and flushing.
   b. Requirements for pipe and fitting exposure to facilitate visual inspections.

C. Refer to Section 21 13 13 "Wet-Pipe Fire Sprinkler System" for interior building systems work that is not a part of this section.

1.2 RELATED WORK IN OTHER SECTIONS

A. General Requirements Division 01

B. Wet-Pipe Fire Sprinkler Systems Section 21 13 13

C. Common Work Results, Plumbing Section 22 05 00

D. Fire Alarm Voice Evacuation System Section 28 30 01

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Firms regularly engaged in manufacture of listed and/or approved fire protection water system equipment and accessories of types, materials, and sizes required and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with fire water work similar to that required for project.

C. Prior to acceptance of the work on private property, obtain/verify acceptance of all work in the public domain from the serving utility and submit copies of the Certificates of Completion to the inspector and owner.

1.4 CODES AND STANDARDS

A. In addition to complying with all pertinent standards, codes and regulations, comply with all requirements of:
4. Oceanside Fire Department policies and standards.
5. Oceanside Water Department requirements.
6. NFPA 13, 24, 25 and 72 (as adopted by the State of California).
7. Underwriters Laboratories (UL) and FM Global (FM) listed products.
8. American Water Works Association (AWWA) requirements and specifications.

B. Other Referenced Standards: Unless otherwise noted on the plans, all work shall conform to the following standard specifications and drawings:

1. Standard Specifications:
   d. Regional Cross-Connection Control and Backflow Prevention Programs.

2. Standard Drawings:
   a. Oceanside Water Department District Standard Drawings.
   b. San Diego Regional Standard Drawings (S.D.R.S.) as Recommended by the Regional Standards Committee, Maintained and Published by the San Diego County Department of Public Works, 2012 edition.

1.5 SUBMITTALS

A. Submit materials data sheets for all proposed product substitutions from the approved plans and data sheets. Substitutions shall be per Division 01 requirements. Also, refer to District Board approved Sole Source Items list in Section 016000 Product Requirements for items which may not be substituted. Statement of equivalency shall accompany items not exactly comparable to the approved product. Substitutions shall be at the contractor's risk, and at no additional expense to the owner.

B. Record Drawings: At project closeout, submit record drawings of installed fire water system piping and products, in accordance with requirements of Division 1.

C. Maintenance Data: Submit maintenance data and parts lists for fire water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 01

1.6 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by District or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
   1. Notify Owner or Construction Manager no fewer than five days in advance of proposed interruption of service.
   2. Do not proceed with interruption of water-distribution service without Owner or Construction Manager's written permission.

PART 2 – PRODUCTS

2.1 IDENTIFICATION

A. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 3" wide x 4 mils thick. Provide tape with printing reading "CAUTION BURIED WATER LINE BELOW" (or similar language).
2.2 PIPE AND PIPE FITTINGS – GENERAL

A. Provide ells, tees, reducing tees, couplings, and other required piping accessories of same type and class of material as conduit, or of material having equal or superior physical and chemical properties as acceptable to Owner’s Architect/Engineer and Inspector.

B. Joints for pipe shall be push-on joints as specified in ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints as specified in ASTM D 3139 or shall be compression-type joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111. Each joint connection shall be provided with an elastomeric gasket suitable for the bell or coupling with which it is to be used.
   1. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipes and metal fittings, valves, and other accessories shall be as specified in AWWA C111 respectively for push-on joints and mechanical-joints.
   2. Mechanically coupled joints, using a sleeve-type mechanical coupling, may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe.

2.3 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

B. Hard Copper Tube: ASTM B 88, Type K or Type L, water tube, drawn temper.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Gaskets: AWWA C111, rubber.

C. Flanges: ASME 16.1, Class 125, cast iron.

2.5 PVC PIPE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900 bell end with gasket and with spigot end, Pressure Class 150/235 (DR 18) with cast-iron-pipe-equivalent OD. Where pressures may exceed 175 PSI, pipe shall be Pressure Class 200/305 (DR 14).
   1. Comply with UL 1285 for fire-service mains as applicable and/or required.
2. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
3. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2.6 POLYETHYLENE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D 2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psig.
   1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 200 psig.
   1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psig.

C. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 200.
   1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

2.7 CHLORINATED POLYVINYL CHLORIDE FIRE PROTECTION PIPE AND FITTINGS

A. CPVC, listed for fire protection per UL 1821.
   1. LISTED FOR FIRE PROTECTION SERVICE

2.8 TRANSITION FITTINGS

A. One-piece riser sweep, 90° fabricated 304 stainless steel.
   1. UL and/or FM approved for fire protection services.
   2. Working pressure rating 200 PSI minimum, equivalent to DR 14.
   3. Vertical end per AWWA C606 for roll groove and C-207 for flanged pipe.
   4. Horizontal end per AWWA C900 and standard ductile iron pipe diameters with UL 157 gasket.

2.9 GATE VALVES

A. Provide flanged or mechanical joint gate valves, listed for fire protection service, 175 psi working pressure for 12" and smaller, 150 psi for sizes larger than 12".
   1. Manufacturer: Clow Valve Co.; Model: 2639
   2. Non-rising-Stem, Resilient-Seated Gate Valves
      a. Description: Ductile-iron body and bonnet; with bronze gate, resilient seats, bronze stem, and stem nut.
      c. End Connections: Push on or mechanical joint.
      d. Interior Coating: Complying with AWWA C550.
   3. OS&Y, Rising-Stem Gate Valves
      a. Description: Ductile-iron body and bonnet, with bronze gate, resilient seats, and bronze stem.
      b. UL 262, FM approved. Minimum Pressure Rating: 175 psig.
      c. End Connections: Flanged.

B. Indicator Posts: UL 789, FM approved, vertical-type, cast-iron body with operating wrench,
extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve. Post shall be listed for use with specific make/model of gate valve.

C. Valve Box and Cap: Telescopic barrel type for use with underground gate valves, cap is to be cast iron and marked "WATER".

2.10 BACKFLOW PREVENTION ASSEMBLY

A. Backflow preventer assembly shall be installed strictly per all requirements and standard drawings of serving water authority. Assembly shall be Reduced Pressure Detector Assembly (RPDA) with metered bypass to detect leaks and unauthorized use.

1. Zurn/Wilkins model 375ASTDA

B. Any proposed assembly shall be U.L. classified and/or FM approved for fire protection service and shall be listed by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

2.11 CHECK VALVES

A. Check valves shall be iron body, bronze mounted, horizontal swing check. As acceptable to authorities having jurisdiction, iron body, bronze, disk wafer check may be used.

B. Check valve shall be U.L./F.M. approved for fire protection use and recommended by the manufacturer for direct bury where such installation is to be required.

1. Where check valve is installed underground, an approved valve box or other means of accessing the valve for inspections and testing shall be furnished and installed.

C. Iron body, bronze disk threaded or grooved swing check may be installed at Fire Department Connection, and located as acceptable to serving fire department.

2.12 FIRE HYDRANTS

A. General: Hydrants shall conform to serving fire department requirements. Number of hydrants, spacing and proximity to fire apparatus lanes shall be in accordance with approved plans.

B. Hydrants shall be wet-barrel type except where subject to freezing.

C. Hydrants shall be furnished with National Standard (fire hose) Threads (NST). Unless noted otherwise there shall be two 4" and one 2½" ports, individually valved and equipped with caps and chains.

2.13 FIRE DEPARTMENT CONNECTIONS

A. Furnish 4" x 2 1/2" two-way, Siamese fire department connection. Finish and model shall be in conformance with serving fire department requirements. Provide check valve per Section 2.11.

B. Fire department connection piping shall be ductile iron, with corrosion protection as specified in this section. No steel piping shall be installed at fire department connections.

2.14 ANCHORAGES

A. General: Provide anchorages for ells, tees, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.


2. Rods: Steel, ASTM A 575.
6. Thrust Blocks: Concrete, minimum 2,500 psi.

2.15 CORROSION PROTECTION

A. Encasement for Underground Metal Piping:
   1. Standards: ASTM A 674 or AWWA C105.
   2. Form: Sheet or tube.
   3. Material: LLDPE film of 0.008-inch minimum thickness.
   4. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
   5. Material: High-density, cross-laminated PE film of 0.004-inch minimum thickness.

B. Dielectric Fittings

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions
   b. Pressure Rating: 250 psig.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig or 300 psig.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric Flange Insulating Kits
   a. Field-assembled companion-flange assembly, full face or ring type.
   b. Non-conducting materials for field assembly of companion flanges.
   c. Pressure Rating: 150 psig or 300 psig.
   d. Gasket: Neoprene or phenolic.
   e. Bolt Sleeves: Phenolic or polyethylene.
   f. Washers: Phenolic with steel backing washers.
5. Dielectric Couplings
   a. Galvanized steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends.
   b. Pressure Rating: 300 psig.
6. Dielectric Nipples
   b. Electroplated steel nipple complying with ASTM F 1545.
   c. Pressure Rating: 300 psig at 225 deg F minimum.
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene.

2.16 ELECTRONIC SUPERVISION

A. Furnish valve supervision, as required by authorities having jurisdiction, at all valves controlling fire protection water supplies, and any required underground conduit thereto.

B. Provide UL/FM approved tamper switch, Model PIVSU-A1, or OSYSU-A1, or UL/FM listed equivalent, 12 or 24 VDC or 120VAC with one set of Form C, single pole, double-throw contacts.

C. Tamper connections shall be furnished and zoned as required by serving fire department.
D. Signals shall be monitored at local fire alarm panel and central station as required and as shown on fire alarm plans.

PART 3 – EXECUTION

3.1 INSTALLATION OF IDENTIFICATION

A. General: During back-filling/top-soiling of underground fire water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6” to 8” below finished subgrade, but at least 6” above the top of pipe.

3.2 INSTALLATION OF PIPE AND PIPE FITTINGS


B. Polyvinyl Chloride Pipe: Install in accordance with manufacturer's installation instructions.

C. Depth of Cover: Provide three (3) foot minimum depth of cover over underground piping.

D. Transition from underground to interior building system the passes under footings and on-grade slab shall utilize a one-piece riser sweep.
   1. Pipe and fittings shall be installed so that no mechanical joints are located below structural footing or slab on grade.
   2. All penetrations of floors and walls shall maintain minimum 2” annular clearance around entire circumference of piping.
   3. All piping shall be restrained using mechanical joint fittings, rods and/or thrust blocks.
   4. All pipe and fittings shall be protected from corrosion as specified in this section.

3.3 INSTALLATION OF VALVES

A. General: Install valves as indicated. Provide post indicator for control valves where shown on plans.

B. Control Valves: Install post indicator valve at each connection into building, locate 40' from building outside wall, or as shown on approved plans.

C. Shutoff Valves: Install shutoff valve ahead of each hydrant.

3.4 CONCRETE PADS

A. As required by serving fire and/or water department, furnish concrete pads under all fire hydrants, backflow prevention assemblies and fire service valve assemblies per standard drawings and details.
   1. Where pipe, fittings and devices are installed in the horizontal position, furnish approved pipe stands or other means of support.

3.5 SIGNAGE

A. Provide signage as required by serving fire department to identify all fire protection system valves and fire department inlet connections. Signs shall be building and system specific and shall be constructed of durable, weather-resistant materials and shall be finished or coated or otherwise protected as required to prevent damage and fading from ultra-violet light.
   1. As required by serving fire authority, signage shall be affixed to valves and inlet connections using lightweight chain with zinc or galvanized finish.
   2. Lettering shall be of the minimum size and color required by serving fire department.
3. Where required, signage shall be installed on posts and elevated above finished grade.

3.6 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline with water 24-hrs prior to testing and apply test pressure to stabilize system.

B. Hydrostatic Tests: Test at not less than 200 psi for 2 hours, or at 50 psi above maximum static pressure where greater than 150 psi.
   1. Test shall be considered a fail if leakage exceeds allowable as prescribed in NFPA 24, or as required by authorities having jurisdiction.
   2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.

C. Upon acceptance of hydrostatic testing by DSA Inspector of Record, the entire fire main system shall be flushed in accordance with the procedures described in NFPA 24. Flow rates shall be as required by NFPA 24, or at the hydraulically calculated water demand rate of the system, whichever is greater.
   1. Erosion and storm drain controls, conformance to local best practices and the collection/treatment of discharge as required shall be the responsibility of this contractor.

D. Operating Tests: Open and close all valves and hydrants under system water pressure. Order required operational tests by serving Fire and Water Departments.

3.7 COMPLETION

A. Closeout
   1. Upon completion and approval of system, and prior to occupancy, provide instruction to the Owner, or Owner's representative, in all details of system operation and maintenance. Prepare and submit maintenance and operation manual per other sections of specifications as applicable.
   2. Provide three copies of final inspection and certification as prescribed by Owner's Insurance Underwriter, and other authorities having jurisdiction.
   3. Furnish fully executed NFPA Materials and Test Certificate to Owner or Owner's representative, local fire authority, architect and to DSA Inspector of Record.
   4. Submit two copies of guarantee per Division 01.
   5. Provide three (3) copies of system "As-Built" record drawings to the Owner or Owner's representative. Drawings shall show actual installation details including all piping and equipment locations, room or facilities modifications, etc. One (1) copy of drawings shall be on reproducible type media.

B. Clean-Up
   1. Equipment, appurtenances, fixtures and exposed piping shall be clean, and all excess dope and oil shall be removed. Sprinkler heads shall be cleaned without the use of any solvents.
   2. Upon completion of work, remove all surplus material, debris, and equipment associated with or used in the execution of this work. Sweep work and storage areas, as required, to remove metal shavings and oily residue.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. Work includes, but is not necessarily limited to, the following work areas:

1. Installation of a complete wet-pipe automatic fire sprinkler systems in all areas shown on plans including all interior compartments, exterior soffits (where required) and combustible concealed spaces if any.
2. Compilation of record drawings by installing contractor, including all field changes and installing contractor’s C-16 license number.
3. Connection of interior fire sprinkler systems to site fire service laterals, at points of connection shown on fire protection and civil site plans.
4. Test valves, drain lines, and all other inspection components.
5. All coring, drilling, sleeving and chasing required for piping installation, as approved by Architect and Structural.
6. Local audible alarm and connection points for central station monitoring, as shown on plans and as specified.
7. Fees, permits, inspections and tests.
8. Meetings and correspondence with project team members to confirm specific requirements for this project, including:
   a. Location and methods of discharging water from test and drain connections.
   b. Zoning and signaling requirements for alarm, detection and monitoring systems.

1.2 RELATED WORK IN OTHER SECTIONS

A. General Commissioning Requirements Section 01 91 13
B. Exterior Painting Section 09 91 13
C. Interior Painting Section 09 91 23
D. Private Fire Main System Section 21 11 00
E. Common Work Results, Plumbing Section 22 05 00
F. Sanitary Waste and Vent Piping Section 22 13 16
G. Digital Addressable Fire Alarm System Section 28 30 01

1.3 QUALITY ASSURANCE

A. Qualifications of Fabricators and Installers

1. For actual fabrication and installation of sprinkler systems, use only personnel who are thoroughly trained and experienced with the products involved, and in the recommended methods of their installation.
2. Installing contractor shall have a California C-16 license and be experienced in design and installation of systems in projects of similar size and scope.
1.4 REFERENCES

A. In addition to complying with all pertinent standards, codes and regulations, comply with all requirements of:
   4. Oceanside Fire Department requirements.
   5. Oceanside Water Department requirements.
   6. NFPA 13, 24, 25 and 72 (as adopted by the State of California).
   7. Underwriters Laboratories (UL) and FM Global (FM) listed products.
   8. ICC Evaluation Service listed products.

1.5 SUBMITTALS

A. Shop Drawings
   1. Within 30 days after award of Contract, submit shop drawings to the Architect for review. A complete submittal shall include the following:
      a. Shop drawings shall be in compliance with approved plans.
      b. Location of all switches, bells and electrical connections for alarm system, as described in this specification.
      c. Location of connections to drain receptors for test and drain discharge.
      d. Where revisions are proposed due to coordination with work of other trades, they shall be clearly illustrated and called out for review.
      e. Where value-engineered revisions are proposed, they shall be clearly illustrated and called out for review.
      f. Notations and identifying marks for fabrication may be included.
   2. Submit materials data sheets for all proposed product substitutions from the approved plans and data sheets. A statement of equivalency shall accompany items that are not exactly comparable to the approved product. Proposed substitutions of hanger and bracing materials shall only be allowed if submitted to and approved by DSA Fire Life Safety and Structural review with all required calculations and written acceptance by project structural engineer. Such substitutions shall be at the contractor’s risk and at no additional expense to the owner.

B. Maintenance Manual
   1. At close-out, submit maintenance manual describing maintenance schedules, replacement parts, and operational requirements.

C. Guarantee
   1. Contractor shall guarantee fixed fire protection system, for a period of two years after date of final inspection, from leaks and other failures from materials and workmanship. Guarantee shall include repair of damage to Owner.

1.6 COORDINATION

A. Coordinate work with that specified in other sections before start of installation. Any installation found to be in conflict with other trades due to neglected coordination, shall be removed and reinstalled as directed by the Architect at no additional expense to the Owner.
B. Contractor shall contact the Architect and obtain necessary information to design fire sprinkler system to fit into allotted spaces without interfering with work by other trades.

C. Coordinate with Plumbing section for size and location of drain receptors, where required or shown for draining and testing fire sprinkler risers and systems. All drain piping shall discharge into the receptors and not through walls or curbs, unless noted otherwise.

PART 2 - PRODUCTS; DESIGN AND MATERIALS

2.1 GENERAL DESIGN CRITERIA

A. Coverage and Scope
   1. Storage, custodial and utility areas shall be protected for Ordinary Hazard. Sprinklers shall be spaced at a maximum coverage of 130 sq. ft. for standard spray sprinklers.
   2. All other areas shall be protected for Light Hazard. Sprinklers shall be spaced at a maximum coverage of 225 sq. ft. for standard spray sprinklers or as shown on plans for sidewall or extended coverage sprinklers.

B. System shall be designed using point of connection as shown on drawings, and as described in this specification.

2.2 MATERIALS AND PRODUCTS - GENERAL

A. All material installed shall be approved and/or listed for fire protection use by the referenced authorities, codes and standards. All material shall be new and without field modifications.

2.3 SPRINKLERS

A. General
   1. All sprinklers shall be of similar make and appearance and shall have the same bulb or link and finish except where otherwise required by exposure to heat sources, freezing temperatures, corrosive environment, etc.

B. Interior Finished Ceilings and Exterior Soffits
   2. Provide recessed standard spray pendent, with white polyester finish and matching escutcheon.
   3. Listed corrosion-resistant sprinklers shall be installed at exterior areas, with white polyester or Teflon finish and matching escutcheon.

B. Concealed Areas, Unfinished Ceilings, and Service Areas
   1. Provide standard spray upright or pendent, with white finish.
   2. Where required, escutcheons shall be two-piece, style #401 with white painted finish at areas with ceilings.

C. Temperature Ratings and Response Type
   1. Sprinklers below finished ceilings, and in all other occupied areas shall have a temperature rating of Ordinary (155-165°F), except as noted below.
      a. Sprinklers in unventilated spaces and under exterior canopies shall have a temperature rating of Intermediate (200-212°F).
      b. Sprinklers in zone of influence of space heaters or other heat-producing equipment shall have a temperature rating of High (250-300°F), unless otherwise required by code.
2.4 HANGERS AND SUPPORTS

A. General

1. Provide hangers approved by UL/FM and NFPA 13 for fire sprinkler systems. Shop fabricated supports shall be designed to meet requirements of NFPA 13, and must be certified by a registered professional engineer.

2. Provide earthquake bracing in accordance with UL/FM, NFPA 13 and ASCE 7. Locations of all bracing shall be shown on shop drawings in conformance with approved plans. All bracing shall be assembled and installed per NFPA 13 and manufacturer’s installation instructions.

3. Size all anchors and fasteners per NFPA 13. All lag screws, bolts and drive screws shall be installed as required by codes and accepted good practices.

4. All fasteners and/or anchors proposed for use in concrete construction shall be specifically listed and approved for use on fire sprinkler systems in seismic zones. Powder-driven studs shall not be used unless all system components including installation tool and pins are listed.

2.5 INTERIOR SPRINKLER PIPE AND FITTINGS

A. General

1. All pipe and fittings shall be new, acceptable to authorities having jurisdiction, per all applicable standards and codes, and free from damage and distortion.

B. Product Characteristics


3. Threaded fittings shall be of cast or malleable iron, class 125 or 150, conforming to ANSI B16.3 and ANSI B16.4.

4. Flanged fittings shall be provided where required. Flanges shall be of cast iron, class 125, conforming to ANSI B16.1.

5. Welded fittings shall be of wrought steel, conforming to ANSI B16.9.

6. One-piece reducing fittings shall be used wherever a change is made in pipe size. Bushings shall not be used, except where fittings of the required size are not available.

7. Grooved thinwall steel pipe connections shall be made using a UL/FM approved ductile iron coupling, with rubber gasket. Installation shall be per manufacturer's instructions.

8. All piping shall be joined with welded, threaded or grooved fittings. Fittings for hole-cut connections are not acceptable.

2.6 ACCESSORY CABINET

A. Furnish metal sprinkler cabinet in riser room, with reserve supply of sprinklers as required by NFPA 13. Include one suitable head wrench for each type of sprinkler installed. Stock shall include all types and temperature ratings.

2.7 SIGNS
2.8 PROTECTION OF SPRINKLERS
A. Provide UL/FM listed guards for sprinkler heads located in areas susceptible to mechanical damage.

2.9 ESCUTCHEON PLATES
A. Provide chrome-plated escutcheons where exposed piping penetrations are made through finished walls and ceilings. Plates shall be painted to resist corrosion when exterior installation is required.

2.10 LOCAL ALARM COMPONENTS
A. Exterior Alarm Bell
   1. Furnish 10" diameter, UL/FM approved bell with identification sign, rated 120VAC, with standard mounting hardware.
   2. Locate as shown on approved plans.
B. Water Flow Switch
   1. Provide UL/FM approved, 120VAC with two sets of Form C, single pole, double throw contacts, and adjustable retard feature.
   2. Retard shall be set by Contractor so as to prevent false alarms, and still allow audible alarm within 30 seconds.

2.11 CENTRAL STATION SUPERVISION
A. General
   1. Furnish supervision at all valves controlling fire protection water supplies, and any required underground conduit thereto.
   2. Provide UL/FM approved tamper switch, Model PCVS-1, or OSYSU-1, or UL/FM listed equivalent, 120VAC with one set of Form C, single-pole, double-throw contacts.

2.12 FIRE DEPARTMENT CONNECTION
A. Provide 4" x 2 ½", single or double clapper 2-way fire department connection. Finish and model shall be as required by serving fire department. Provide check valve per Section 2.14B.

2.13 VALVE COMPONENTS
A. Control Valve
   1. Provide iron, double disc, bronze-mounted gate valve, with adjustable indicator post.
   2. Post shall be compatible with valve, and be field painted as required by serving fire department.
B. Backflow Prevention and Check Valves
1. Check valves shall be iron body, bronze mounted, horizontal swing check. As acceptable to authorities having jurisdiction, iron body, bronze, disk wafer check may be used.

2. Check valve shall be U.L/FM approved for fire protection use, and recommended by the manufacturer for direct bury where such installation is to be required.

3. Iron body, bronze disk threaded or grooved swing check may be installed at Fire Department Connection, and located as acceptable to serving fire department.

C. Interior Drain/Test Valves

1. Furnish listed combination test and drain valve at riser, as shown on the approved plans. Provide pressure relief type, with bypass.

2. Where auxiliary drainage is required, provide brass, rubber disc, angle or globe pattern, with screwed ends, rated 200psi WOG.

2.14 VALVE CHART

A. Provide chart in enclosed frame, indicating all valve locations functions.

2.15 UNDERGROUND PIPE AND FITTINGS

A. General

1. All pipe and fittings shall be new, acceptable to authorities having jurisdiction, comply with all applicable standards and codes, and free from damage and distortion.

B. Product Characteristics

1. Pipe shall be cast or ductile iron, or C-900 PVC, as shown on plans or required by water department. Pipe under structural footings shall be cast or ductile iron only, to at least 5'-0" beyond outside face of building.

2. Fittings shall be ductile iron, class 250, flanged or mechanical joints as required. Proper thrust restraint shall be provided per NFPA 24.

3. All hardware installed below-grade, including studs, bolts, nuts, washers, thrust-restraint rods, etc. shall be stainless steel conforming to UNS 31600 (formerly AISI Type 316). Hex-head bolts shall conform to ASTM F593, Alloy Group 2, Condition CW1/CW2 (depending on size). Hex nuts shall conform to ASTM F594, Alloy Group 2, Condition CW1/CW2 (depending on size). T-bolts shall be stamped to show conformance with UNS 31600.

PART 3 - EXECUTION

3.1 JOB SITE CONDITIONS

A. Inspection

1. Prior to all work of this section carefully inspect the installed work of other sections, and verify that all such work is complete to the point where this portion of the work may properly commence in accordance with all submittals, designs, and applicable codes.

B. Discrepancies

1. In the event of a discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies and/or omissions have been fully reviewed and clarified.
3.2 FABRICATION

A. General

1. All pipe, fittings, and materials shall be prepared by qualified personnel, trained and experienced with the products involved, and the recommended methods of preparation.
2. All pipe cuts, threads, and grooves shall be made according to applicable codes, standards and accepted good practices.
3. Pipe shall be free of damage, flaws and burrs. Threads and grooves shall not be excessively shallow or deep.
4. Fittings shall be made onto the pipe no tighter than necessary. Cracked or broken fittings shall be replaced, without exception.
5. Excess dope and oils shall be removed before shipment to job site.

B. Welding

1. Welding methods shall comply with NFPA 13 and AWS B2.1. Contractor shall be responsible for all welded joints and any qualifying procedures for welders and related personnel.
2. Holes in pipe for outlets shall be cut to full inside diameter of fitting, prior to welding in place. Holes shall be free of slag and welding residue and of smooth bore. Fittings shall not penetrate internal diameter of run piping. Holes shall be cut by hole-saw or other rotary bit. Torch-cutting of holes is prohibited.

3.3 INSTALLATION

A. General

1. All installations shall be per referenced standards. Follow manufacturer's directions and recommendations in all cases as required for all approvals and warranty enforcement.
2. All cutting of structure shall be subject to approval by the Architect. Beams, decks and other structural components shall not be cut or altered in any way unless previously approved.
3. Provide flexible couplings where required to provide expansion capability, and for earthquake protection per NFPA 13. Provide sway bracing as required by coupling locations.
4. Entire sprinkler system shall be installed in such a manner so that it can be drained in accordance with NFPA 13. Drains shall be located at suitable points as approved by Architect. No primary or auxiliary drain shall be located in any public area or electrical room. All drains shall discharge into dedicated receptors.
5. No work shall be covered or enclosed until inspected, tested, and approved by Architect and/or authority having jurisdiction. Should any work be concealed before inspection, the Contractor shall, at Contractor's expense, uncover such work and after it has been inspected, tested and approved, provide for all repairs as may be necessary to restore work to original and proper condition.
6. Sprinklers at finished ceilings and in exposed locations shall form a symmetrical pattern and shall be located at the exact centerline of 2’ square ceiling tiles and “Second Look” tile modules. Where 2’ x 4’ ceilings occur, sprinklers shall be centered in the 2’ direction with escutcheons at least 6” clear of ceiling T-bars.
7. Sprinkler layout shall accommodate lighting and HVAC register locations. Coordination with the work of these sections is the responsibility of Contractor.
8. Without exception, no piping shall be run under or through any skylight or skylight well. Any additional upright or pendent sprinklers, which may be required by skylight locations, shall be the responsibility of this contractor.
9. All penetrations of wall and floor assemblies shall be suitably sleeved, patched and/or sealed in order to preserve fire rating, where applicable.
10. Location of control valves, fire department connection, and inspector's test shall be as required by authorities having jurisdiction, and as approved by Architect.
11. Local alarm bells shall be located so as to be easily heard and seen by passersby and fire department personnel. Locate on exterior wall, 10'-0" – 12'-0" above finished grade.

12. Provide wood or metal floor pans under and around pipe cutting/threading machines to protect floor surfaces from damage and discoloration.

13. Paint all fire sprinkler piping risers, drops and other components exposed to view in final construction as directed by Architect and per Section 09 91 23.

14. Underground pipe and fittings shall be installed per NFPA 24, and applicable local codes and standards. Trenching, back-filling, depth of bury and size, shape and location of all thrust blocks shall be acceptable to all jurisdictional agencies.

3.4 FIELD QUALITY CONTROL

A. Testing
1. Perform all tests as required by NFPA 13, and all authorities having jurisdiction. Maintain an accurate record of all tests and inspections on the job site, including date of test and inspecting agency.

2. Before connection of interior system to underground main, underground piping shall be hydrostatically tested, flushed and accepted by authorities having jurisdiction. Provide documentation of acceptance by jurisdictional authority. All required health and bacterial tests shall be the responsibility of Contractor.

3.5 COMPLETION

A. Closeout
1. Upon completion and approval of system, and prior to occupancy, provide instruction to the Owner, or Owner's representative, in all details of system operation and maintenance. Prepare and submit maintenance and operation manual per other sections of specifications as applicable.

2. Provide three copies of final inspection and certification as prescribed by Owner's Insurance Underwriter, and other authorities having jurisdiction.

3. Furnish fully executed NFPA Materials and Test Certificate to Owner or Owner's representative, local fire authority, architect and to DSA.

4. Submit two copies of guarantee per Section 01 78 39.

5. Provide three (3) copies of system "As-Built" drawings to the Owner or Owner's representative. Drawings shall show actual installation details including all piping and equipment locations, room or facilities modifications, etc. One (1) copy of drawings shall be on reproducible type media.

B. Clean Up
1. Equipment, appurtenances, fixtures and exposed piping shall be clean, and all excess dope and oil shall be removed. Sprinkler heads shall be cleaned without the use of any solvents.

2. Upon completion of work, remove all surplus material, debris, and equipment associated with or used in the execution of this work. Sweep work and storage areas, as required, to remove metal shavings and oily residue.
Section 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
7. Plumbing demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.


G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS
A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
C. Pressure Plates: Carbon steel. Include two for each sealing element.
D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES
A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.
E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS
A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.
D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.
2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.


2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.


PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section “Cutting and Patching” and Division 02 Section “Selective Structure Demolition” for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Equipment to Be Removed: Disconnect and cap services and remove equipment.

3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

4. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

5. Prior to any Disconnection/Demo/Connection of any wet utilities, this work shall be coordinated with John Furuta (LAHD).

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.
G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install piping to allow application of insulation.
K. Select system components with pressure rating equal to or greater than system operating pressure.
L. Install escutcheons for penetrations of walls, ceilings, and floors.
M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
Q. Verify final equipment locations for roughing-in.
R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION
A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 2855.
   7. PVC Nonpressure Piping Gasketed Joints: Join according to ASTM D 3139.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES.

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Sleeve-seal systems.
   4. Sleeve-seal fittings.
   5. Grout.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. GPT; an EnPro Industries company.
B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

2. Zurn Industries, LLC.

B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Proco Products, Inc.

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber, High-temperature-silicone or Nitrile Buna N interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel, Stainless steel, Type 316.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633, Stainless steel, Type 316 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Proco Products, Inc.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT
A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Dow Corning Corporation.
   b. Polymeric Systems, Inc.
   c. Sherwin-Williams Company (The).

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Smooth-On.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.
C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

F. Sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
   3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
   4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
C. Secure nailing flanges to concrete forms.
D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves, Steel pipe sleeves or Sleeve-seal fittings.
      b. Piping NPS 6 and Larger: Cast-iron pipe sleeves, Steel pipe sleeves or Sleeve-seal fittings.
   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade:
a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
   
   1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
   
   1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:
   
   a. Piping Smaller Than NPS 6: Steel pipe sleeves, PVC pipe sleeves, Stack-sleeve fittings, Sleeve-seal fittings, Molded-PE or -PP sleeves or Molded-PVC sleeves.
   
   b. Piping NPS 6 and Larger: Steel pipe sleeves, PVC pipe sleeves or Stack-sleeve fittings.

5. Interior Partitions:
   
   a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves.
   
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
4. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed or exposed-rivet hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping and Relocated Existing Piping:

   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
   b. Chrome-Plated Piping: One-piece steel or split-casting brass with polished, chrome-plated finish.
   c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
   d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
   e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
   f. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
   i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
   j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
   m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
   n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
   p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
   q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
   s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.
   t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped
steel with concealed hinge with polished, chrome-plated finish.

2. **Escutcheons for Existing Piping to Remain:**
   a. Chrome-Plated Piping: Split-casting, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
   f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping and Relocated Existing Piping: One-piece, floor plate.
   2. Existing Piping: Split floor plate.

3.2 **FIELD QUALITY CONTROL**

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION
Section 22 05 19

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
4. Thermowells.
5. Dial-type pressure gages.
7. Test plugs.
8. Test-plug kits.

B. Related Requirements:

1. Section 221119 “Domestic Water Piping Specialties” for water meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Ashcroft Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Glass Thermometer Corp.


C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch to 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle, rigid, back, and/or rigid, bottom, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass or plastic.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ashcroft Inc.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.


3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch to 6-inch nominal diameter.

4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical, with link to pressure element and connection to pointer.

6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.


8. Window: Glass or plastic.

9. Ring: Metal or Stainless steel.

10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device or with rigid back and bottom; with ASME B1.1 screw threads.

11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Trerice, H. O. Co.


3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Back angle or Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 THERMOWELLS

A. Thermowells:

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell’s internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

3. Case: Liquid-filled or Sealed, Open-front or Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch to 6-inch nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.


9. Window: Glass or plastic.

10. Ring: Metal, Brass or Stainless steel.

11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Flow Design, Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Glass Thermometer Corp.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.8 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Flow Design, Inc.
2. Sisco Manufacturing Company, Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.

B. Furnish one test-plug kit containing one thermometer, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be at least 0 to 200 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.9 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ARCHON Industries, Inc.
2. Emerson Process Management; Rosemount Division.
3. Ernst Flow Industries.
4. Pentair Valves & Controls; Penberthy Brand.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig or 150 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid, one-third of pipe diameter or to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:
   1. Inlet and outlet of each water heater.
   2. Inlets and outlets of each domestic water heat exchanger.
   3. Inlet and outlet of each domestic hot-water storage tank.
   4. Inlet and outlet of each remote domestic water chiller.
   5. Inlet and outlet of domestic hot water recirculation system.

L. Install pressure gages in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.
   3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
   1. Liquid-filled or Sealed, bimetallic-actuated type.
   2. Direct-mounted, metal or plastic-case, vapor-actuated type.
   4. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
   1. Liquid-filled or Sealed, bimetallic-actuated type.
   2. Direct-mounted, metal or plastic-case, vapor-actuated type.
   4. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
1. Liquid-filled or Sealed, bimetallic-actuated type.
2. Direct-mounted, metal or plastic-case, vapor-actuated type.
4. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.
B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:
   1. Liquid-filled or Sealed, Open-front, pressure-relief or Solid-front, pressure-relief type, direct-mounted, metal case.
   2. Sealed, direct-mounted, plastic case.
   3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
   1. Liquid-filled or Sealed, Open-front, pressure-relief or Solid-front, pressure-relief type, direct-mounted, metal case.
   2. Sealed, direct-mounted, plastic case.
   3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
   1. Liquid-filled or Sealed, Open-front, pressure-relief or Solid-front, pressure-relief type, direct-mounted, metal case.
   2. Sealed, direct-mounted, plastic case.
   3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping: 0 to 200 psi.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
4. Bronze swing check valves.
5. Bronze gate valves.
8. Chainwheels.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene-diene terpolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Protect threads, flange faces, grooves, and weld ends.
4. Set ball valves open to minimize exposure of functional surfaces.
5. Set check valves in either closed or open position.
6. Set gate valves closed to prevent rattling.
7. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. RS Valves in Insulated Piping: With 2-inch stem extensions.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Bypass and Drain Connections: MSS SP-45.

J. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handlever: For quarter-turn valves smaller than NPS 6.
   3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.

K. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. KITZ Corporation.

2. Description:
   b. CWP Rating: 400 psig.
   c. Body Design: One piece.
   d. Body Material: Forged brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass or stainless steel.
   h. Ball: Chrome-plated brass or stainless steel.
   i. Port: Reduced.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. KITZ Corporation.
   d. NIBCO INC.
   e. Red White Valve Corp.

2. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

C. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. KITZ Corporation.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
2. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   l. Port: Full.

D. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Regular.

E. Brass Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Regular.

F. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Jomar Valve.
   b. KITZ Corporation.
   c. WATTS.

2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

G. Brass Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Marwin Valve; Richards Industries.

2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One-Piece with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. NIBCO INC.
   d. WATTS.

2. Description:
   b. CWP Rating: 400 psig.
   c. Body Design: One piece.
   d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Bronze Ball Valves, One-Piece with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. NIBCO INC.
   c. WATTS.

2. Description:

   b. CWP Rating: 600 psig.
   c. Body Design: One piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Reduced.

C. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:

   a. Standard: MSS SP-110 or MSS-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Bronze or brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

D. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Press.
g. Seats: PTFE or RTPFE.
h. Stem: Bronze or brass.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. O-Ring Seal: EPDM or Buna-N.

E. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS.

2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

F. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. WATTS.

2. Description:

b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

G. Bronze Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Hammond Valve.
   c. NIBCO INC.
   d. WATTS.

2. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Regular.

H. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. WATTS.

2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Bronze or brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

I. Bronze Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. WATTS.
2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

J. Bronze Ball Valves, Three-Piece with Regular Port and Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Jamesbury; Metso.
      c. NIBCO INC.

2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Bronze.
   e. Ends: Threaded or soldered.
   f. Seats: PTFE.
   g. Stem: Bronze.
   h. Ball: Chrome-plated brass.
   i. Port: Regular.

K. Bronze Ball Valves, Three-Piece with Regular Port and Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Jamesbury; Metso.
      c. NIBCO INC.

2. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Bronze.
   e. Ends: Threaded or soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Regular.

L. Bronze Ball Valves, Two-Piece, Safety-Exhaust:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Jamesbury; Metso.
   c. NIBCO INC.

2. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
   i. Port: Full.

2.4 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Crane; Crane Energy Flow Solutions.
   b. Jenkins Valves; Crane Energy Flow Solutions.
   c. Stockham; Crane Energy Flow Solutions.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

B. Bronze Lift Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. KITZ Corporation.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. WATTS.

2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig.
   e. Ends: Threaded or soldered. See valve schedule articles.
Disc: NBR, PTFE.

2.5 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. KITZ Corporation.
   c. NIBCO INC.
   d. Stockham; Crane Energy Flow Solutions.

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Crane; Crane Energy Flow Solutions.
   c. KITZ Corporation.
   d. NIBCO INC.

2. Description:
   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: PTFE.

C. Bronze Swing Check Valves with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Crane; Crane Energy Flow Solutions.
   c. KITZ Corporation.
   d. NIBCO INC.

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Crane; Crane Energy Flow Solutions.
   b. FNW; Ferguson Enterprises, Inc.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:

   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: PTFE.

2.6 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. KITZ Corporation.
   d. NIBCO INC.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   d. Ends: Threaded or solder joint.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.

B. Bronze Gate Valves, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FNW; Ferguson Enterprises, Inc.
   c. KITZ Corporation.
   d. NIBCO INC.
2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig.
   d. Ends: Threaded or solder joint.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.

C. Bronze Gate Valves, NRS, Class 150:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. KITZ Corporation.
      c. NIBCO INC.
      d. WATTS.
   2. Description:
      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 300 psig.
      d. Ends: Threaded.
      e. Stem: Bronze.
      f. Disc: Solid wedge; bronze.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron, bronze, or aluminum.

D. Bronze Gate Valves, RS, Class 150:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. KITZ Corporation.
      c. NIBCO INC.
      d. WATTS.
   2. Description:
      a. Standard: MSS SP-80, Type 2.
      b. CWP Rating: 300 psig.
      d. Ends: Threaded.
      e. Stem: Bronze.
      f. Disc: Solid wedge; bronze.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron, bronze, or aluminum.

2.7 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. KITZ Corporation.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM or NBR.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Aluminum bronze.

B. Iron, Single-Flange Butterfly Valves with Ductile-Iron Disc:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. KITZ Corporation.
      c. Milwaukee Valve Company.
      d. NIBCO INC.

   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
      d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
      e. Seat: EPDM or NBR.
      f. Stem: One- or two-piece stainless steel.
      g. Disc: Nickel-plated or nickel-coated ductile iron.

C. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. KITZ Corporation.
      c. Milwaukee Valve Company.
      d. NIBCO INC.

   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating, NPS 12 and Smaller: 200 psig.
      c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM or NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.8 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

A. Ductile Iron, Grooved-End Butterfly Valves, 175 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Kennedy Valve Company; a division of McWane, Inc.
   b. Tyco Fire Products LP.
   c. Victaulic Company.
   d. Zurn Industries, LLC.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 175 psig.
   c. Body Material: Coated, ductile iron.
   e. Disc: Coated, ductile iron.
   f. Seal: EPDM.

B. Ductile Iron, Grooved-End Butterfly Valves, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Mueller Steam Specialty; A WATTS Brand.
   b. NIBCO INC.
   c. Tyco Fire Products LP.
   d. Victaulic Company.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating, NPS 8 and Smaller: 300 psig.
   c. CWP Rating, NPS 10 and Larger: 200 psig.
   d. Body Material: Coated, ductile iron.
   e. Stem: Two-piece stainless steel.
   f. Disc: Coated, ductile iron.
   g. Seal: EPDM or NBR.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

F. Check Valves: Install check valves for proper direction of flow.
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

G. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If ball valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Grooved-End Copper Tubing and Steel Piping: Grooved.

C. If check valve applications are not indicated, use the following:
1. **Pump-Discharge Check Valves:**
   
a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
   
b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
   
c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

D. Use gate valves for shutoff service only.

3.5 **DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE**

A. **Pipe NPS 2 and Smaller:**

1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.
2. Bronze ball valve, one piece with bronze or stainless steel trim. Provide with threaded or solder-joint ends.
3. Brass ball valves, two-piece with full-port and brass or stainless steel trim. Provide with threaded or solder-joint ends.
4. Bronze ball valves, two-piece with full-port and bronze, brass or stainless steel trim. Provide with threaded or solder-joint ends.
5. Brass ball valves, three-piece with full port and brass or stainless steel trim.
6. Bronze ball valves, three-piece with full port and bronze, brass or stainless steel trim.
7. Bronze ball valves, two-piece with regular port and bronze or stainless-steel trim.
8. Bronze swing check valves with bronze disc, Class 125 or Class 150, with soldered or threaded end connections.
9. Bronze gate valves, NRS, RS, Class 125 or Class 150 with soldered or threaded ends.

B. **Pipe NPS 2-1/2 and Larger:**

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full-port.
3. Iron ball valves, Class 150.
4. Iron swing check valves with metal seats, Class 125 or Class 250, with threaded or flanged end connections.
5. Iron swing check valves with closure control lever and spring or weight, Class 125, with threaded or flanged end connections.
6. Iron, grooved-end swing check valves, 300 CWP.
7. Iron, center-guided check valves with compact wafer, Class 125, Class 150, Class 250 or Class 300.
8. Iron, center-guided check valves with globe, metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.
9. Iron, dual-plate check valves with metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.
10. Iron, single-plate check valves with resilient seat, Class 125 or Class 250, with threaded or flanged end connections.
11. Iron gate valves, NRS, OS&Y, Class 125 or Class 250 with flanged ends.
13. Ductile-Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.

END OF SECTION
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal hanger-shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Pipe-positioning systems.
   8. Equipment supports.

B. Related Requirements:
   1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers.
   2. Metal framing systems.
   3. Pipe stands.
   4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of trapeze hangers.
   2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.
1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.3 TRAPEZE PIPE HANGERS
A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. B-line, an Eaton business.
b. Flex-Strut Inc.
c. G-Strut.
d. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.


4. Channels: Continuous slotted carbon-steel, stainless-steel, Type 304, stainless-steel, Type 316 or extruded-aluminum channel with inturned lips.

5. Channel Width: Selected for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.


8. Metallic Coating: Pregalvanized G90, Electroplated zinc, Hot-dip galvanized or Gold (yellow zinc dichromate) galvanized.

9. Paint Coating: Green epoxy, acrylic, or urethane.

10. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. Anvil International.
b. ERICO International Corporation.
c. MIRO Industries, Inc.
d. PHD Manufacturing, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.


4. Channels: Continuous slotted carbon-steel or Stainless-steel channel with inturned lips.

5. Channel Width: Select for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.


9. Paint Coating: Green epoxy, acrylic, or urethane.

10. Plastic Coating: PVC.
2.5 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Carpenter & Paterson, Inc.
2. ERICO International Corporation.
3. Pipe Shields Inc.
4. Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Hilti, Inc.
   b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   c. MKT Fastening, LLC.
   d. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. B-line, an Eaton business.
   b. Empire Tool and Manufacturing Co., Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head; Illinois Tool Works, Inc.

2. Indoor Applications: Zinc-coated or stainless steel.

2.7 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:
   1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Hardware: Galvanized steel or polycarbonate.

C. Low-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Vertical Members: Two galvanized or stainless-steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: Adjustable horizontal, galvanized or stainless-steel pipe support channels.
   5. Pipe Supports: Strut clamps, Clevis hanger or Swivel hanger.
   6. Hardware: Galvanized or Stainless steel.
   8. Height: 12 inches above roof.

D. High-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Single vulcanized rubber or molded polypropylene.
   3. Vertical Members: Two galvanized or stainless-steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: One adjustable-height, galvanized or stainless-steel, pipe-support slotted channel or plate.
   5. Pipe Supports: Clevis hanger or Swivel hanger.
   6. Hardware: Galvanized or Stainless steel.
   7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
   8. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: Two or more; vulcanized rubber or molded polypropylene.
   3. Vertical Members: Two or more, galvanized or stainless-steel channels.
   4. Horizontal Members: One or more, adjustable-height, galvanized or stainless-steel pipe support.
   5. Pipe Supports: Strut clamps, Clevis hanger or Swivel hanger.
   6. Hardware: Galvanized or Stainless steel.
   7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
   8. Height: 36 inches above roof.
F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 PIPE-POSITIONING SYSTEMS
A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS
A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.10 MATERIALS
A. Aluminum: ASTM B 221.
B. Carbon Steel: ASTM A 1011/A 1011M.
C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.
D. Stainless Steel: ASTM A 240/A 240M.
E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION
A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION
A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

   b. NPS 4: 12 inches long and 0.06 inch thick.

   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

   2. Obtain fusion without undercut or overlap.

   3. Remove welding flux immediately.

   4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in specification division 09.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to
NPS 24 if little or no insulation is required.

4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.


10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.

11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.

17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.

18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.

19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.

20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit
variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.

1.3 DEFINITIONS


C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an evaluation service member of Division of State Architects Office (D.S.A.) or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number, or Division of State Architects Office (D.S.A.), or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: A, B, C, D, E or F.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I, II or III.
   a. Component Importance Factor: 1.0 or 1.5 or per project specifics.
   b. Component Response Modification Factor: 1.5, 2.5, 3.5 or 5.0.
   c. Component Amplification Factor: 1.0 or 2.5.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second):
4. Design Spectral Response Acceleration at 1.0-Second Period:
5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.
   a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth, Ribbed or Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
   a. Surface Pattern: Smooth, Ribbed or Waffle pattern.
   b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.

2. Mounting Plates:
   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.

2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   a. Housing: Cast-ductile iron or welded steel.
   b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.


7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top housing with threaded mounting holes and internal leveling device.

2.7 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
c. Kinetics Noise Control, Inc.
d. Mason Industries, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top plate with threaded mounting holes or elastomeric pad.
   c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

5. Minimum Additional Travel: 50 percent of the required deflection at rated load.


7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-REstrained-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.
2.10 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Novia; A Division of C&P.
4. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.

2.14 RERAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RERAINT CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Gripple Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Vibration & Seismic Technologies, LLC.

B. Restraint Cables: ASTM A 603 galvanized and/or ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 SEISMIC-RERAINTACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. B-line, an Eaton business.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.17 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.18 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in specification division 03.

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:
   1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   3. Install seismic-restraint devices using methods approved by an evaluation service member of Division of State Architects Office (D.S.A.) or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of Division of State Architects Office (D.S.A.) or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Samples: For color, letter style, and graphic representation required for each identification material and device.
C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
D. Valve numbering scheme.
E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Brady Corporation.
   b. Craftmark Pipe Markers.
   c. Kolbi Pipe Marker Co.
   d. Seton Identification Products.
2. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.


4. Background Color: Black.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. Craftmark Pipe Markers.
   c. Kolbi Pipe Marker Co.
   d. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


4. Background Color: Black.

5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.


9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.

2. Craftmark Pipe Markers.

3. Marking Services Inc.
4. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


D. Background Color: Black.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
4. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping, At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 STENCILS

A. Stencils for Piping:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brimar Industries, Inc.
   b. Craftmark Pipe Markers.
   c. Kolbi Pipe Marker Co.
   d. Marking Sevices Inc.

2. Lettering Size: Size letters according to ASME A13.1 for piping, At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

3. Stencil Material: Aluminum, Brass, Fiberboard or metal.

4. Stencil Paint: Exterior, gloss, alkyl enamel or acrylic enamel paint type in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

5. Identification Paint: Exterior, alkyl enamel or acrylic enamel paint type in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Brady Corporation.
   2. Craftmark Pipe Markers.
   4. Seton Identification Products.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link chain or beaded chain.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Brady Corporation.
   2. Craftmark Pipe Markers.
   4. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with locations of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting." or Section 099600 "High-Performance Coatings."
B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  1. Identification Paint: Use for contrasting background.

C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:
   1. Domestic Water Piping
      a. Background: Safety green.
   2. Natural Gas Piping
      a. Background: Safety yellow.
      b. Letter Colors: Black.
   3. Sanitary Waste, Vent and Storm Drainage Piping:
      a. Background Color: Safety green.

3.5 VALVE-TAG INSTALLATION
A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Domestic Water: 1-1/2 inches or 2 inches, round.
      b. Natural Gas: 1-1/2 inches or 2 inches, round.
   2. Valve-Tag Colors:
      b. Natural Gas: Natural.
   3. Letter Colors:
      a. Domestic Water: Black.
      b. Natural Gas: Black.

3.6 WARNING-TAG INSTALLATION
A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes insulating the following plumbing piping services:
   1. Domestic hot-water piping.
   2. Domestic recirculating hot-water piping.
   3. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
B. Sustainable Design Submittals:
   1. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.
D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
   4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:
   a. One 10-foot section of NPS 2 straight pipe.
   b. One each of a 90-degree threaded, welded, and flanged elbow.
   c. One each of a threaded, welded, and flanged tee fitting.
   d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
   e. Four support hangers including hanger shield and insert.
   f. One threaded strainer and one flanged strainer with removable portion of insulation.
   g. One threaded reducer and one welded reducer.
   h. One pressure temperature tap.
   i. One mechanical coupling.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.
D. Comply with the following applicable standards and other requirements specified for miscellaneous components:


1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Pittsburgh Corning Corporation.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. K-Flex USA.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. CertainTeed Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Knauf Insulation.
   d. Manson Insulation Inc.
   e. Owens Corning.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Manson Insulation Inc.
   d. Owens Corning.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Phenolic:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Kingspan Tarec Industrial Insulation NV.
b. Resolco International BV.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.

3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.


K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Armacell LLC.
   b. Nomaco Insulation.

2.2 INSULATING CEMENTS


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ramco Insulation, Inc.


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ramco Insulation, Inc.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. K-Flex USA.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Dow Corning Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. P.I.C. Plastics, Inc.
   d. Speedline Corporation.

2.4 MASTICS
A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
2. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Knauf Insulation.
   d. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Knauf Insulation.
   d. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: 60 percent by volume and 66 percent by weight.


2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Vimasco Corporation.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

4. Service Temperature Range: 0 to plus 180 deg F.


2.6 SEALANTS

A. Joint Sealants for Cellular-Glass and Phenolic Products:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F.

5. Color: White or gray.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”

B. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Foster Brand; H. B. Fuller Construction Products.
   b. Vimasco Corporation.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
   c. Proto Corporation.
   d. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White or Color-code jackets based on system. Color as selected by Architect when exposed within building.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Pittsburgh Corning Corporation.
   b. Polyguard Products, Inc.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
c. Knauf Insulation.
d. Venture Tape.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
   c. Knauf Insulation.
   d. Venture Tape.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Compac Corporation.
   c. Venture Tape.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. RPR Products, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Insul-Tect Products Co.
   b. McGuire Manufacturing.
   c. Plumberex Specialty Products, Inc.
   d. Truebro.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Truebro.
   b. Zurn Industries, LLC.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retadders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches to 4 inches o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation.
Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word “union.” Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of polyolefin pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

E. All adhesive shall be as recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.

F. Per ASHRAE 189.1, All adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water (HW Return):

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
   b. Flexible Elastomeric: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Phenolic: 1 inch thick.
   e. Polyolefin: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
   b. Flexible Elastomeric: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Phenolic: 1 inch thick.
   e. Polyolefin: 1 inch thick.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   c. Polyolefin: 1 inch thick.
C. Condensate Drain Piping where installed within building:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Cellular Glass: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:
      b. Flexible Elastomeric: 1 inch thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. None.
   2. PVC, Color-Coded by System: 20 mils or 30 mils thick.
   3. Aluminum, Smooth or Corrugated: 0.020 inch, 0.032 inch or 0.040 inch thick.
   4. Painted Aluminum, Smooth or Corrugated: 0.020 inch or 0.032 inch thick.
   5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch or 0.024 inch thick.

D. Piping, Exposed:
   1. None.
   2. PVC, Color-Coded by System: 20 mils or 30 mils thick.
   3. Aluminum, Smooth or Corrugated: 0.020 inch, 0.032 inch or 0.040 inch thick.
   4. Painted Aluminum, Smooth or Corrugated: 0.020 inch or 0.032 inch thick.
   5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch or 0.024 inch thick.

3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
5. Motorized gas valves.
6. Earthquake valves.
7. Pressure regulators.
8. Service meters.
9. Dielectric fittings.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars with supports.
6. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
1. Shop Drawing Scale: 1/4 inch to 1/8 per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves, pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.
1.9 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Architect’s, Construction Manager’s or Owner’s written permission.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less but not more than 2 psig.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
   a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) GE Oil & Gas.
      2) Smith-Blair, Inc.
   b. Stainless-steel or Steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.
   d. Stainless-steel or Steel bolts, washers, and nuts.
   e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Parker Hannifin Corporation.
      b. TracPipe CounterStrike; OmegaFlex, Inc.
      c. Tru-Flex Metal Hose Corp.
      d. Ward Manufacturing LLC.
   3. Coating: PE with flame retardant.
      a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
         1) Flame-Spread Index: 25 or less.
         2) Smoke-Developed Index: 50 or less.
   4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
   5. Striker Plates: Steel, designed to protect tubing from penetrations.
   6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
   7. Operating-Pressure Rating: 5 psig.

C. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.

2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

   b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
   c. Aboveground Portion: PE transition fitting.
   d. Outlet shall be threaded or flanged or suitable for welded connection.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
   b. Outlet shall be threaded or flanged or suitable for welded connection.
   c. Bridging sleeve over mechanical coupling.
   d. Factory-connected anode.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Lyall, R. W. & Company, Inc.
      2) Mueller Co.
      3) Perfection Corporation.
   b. PE body with molded-in, stainless-steel support ring.
   c. Buna-nitrile seals.
   d. Acetal collets.
   e. Electro-zinc-plated steel stiffener.

6. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Lyall, R. W. & Company, Inc.
      2) Mueller Co.
      3) Perfection Corporation.
   b. Fiber-reinforced plastic body.
   c. PE body tube.
d. Buna-nitrile seals.
e. Acetal collets.
f. Stainless-steel bolts, nuts, and washers.

7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) GE Oil & Gas.
      2) Smith-Blair, Inc.
   b. Stainless-steel or Steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.
   d. Stainless-steel or Steel bolts, washers, and nuts.
   e. Factory-installed anode for steel-body couplings installed underground.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
   4. Corrugated stainless-steel tubing with polymer coating.
   5. Operating-Pressure Rating: 0.5 psig.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
   1. Copper-alloy convenience outlet and matching plug connector.
   2. Nitrile seals.
   3. Hand operated with automatic shutoff when disconnected.
   4. For indoor or outdoor applications.
   5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2and larger.
   3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

D. Basket Strainers:
   1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2and larger.
   3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.


C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inch to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig.
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. A.Y. McDonald Mfg. Co.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. BrassCraft Manufacturing Co.; a Masco company.
d. Lyall, R. W. & Company, Inc.
e. Perfection Corporation.


3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A.Y. McDonald Mfg. Co.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. BrassCraft Manufacturing Co.; a Masco company.
   d. Lyall, R. W. & Company, Inc.
   e. Perfection Corporation.

3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A.Y. McDonald Mfg. Co.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. BrassCraft Manufacturing Co.; a Masco company.
   d. Lyall, R. W. & Company, Inc.
   e. Perfection Corporation.

3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A.Y. McDonald Mfg. Co.
   b. Lee Brass Company.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A.Y. McDonald Mfg. Co.
   b. Mueller Co.
   c. Xomox Corporation.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

I. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A.Y. McDonald Mfg. Co.
   b. Flowserve Corporation.
   c. Milliken Valve Company.
   d. Mueller Co.
2. Body: Cast iron, complying with ASTM A 126, Class B.

3. Plug: Bronze or nickel-plated cast iron.

4. Seat: Coated with thermoplastic.

5. Stem Seal: Compatible with natural gas.


7. Operator: Square head or lug type with tamperproof feature where indicated.

8. Pressure Class: 125 psig.

9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

J. PE Ball Valves: Comply with ASME B16.40.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Kerotest Manufacturing Corp.
   b. Lyall, R. W. & Company, Inc.
   c. Perfection Corporation.

2. Body: PE.

3. Ball: PE.


5. Seats and Seals: Nitrile.

6. Ends: Plain or fusible to match piping.

7. CWP Rating: 80 psig.

8. Operating Temperature: Minus 20 to plus 140 deg F.

9. Operator: Nut or flat head for key operation.

10. Include plastic valve extension.

11. Include tamperproof locking feature for valves where indicated on Drawings.

K. Valve Boxes:

1. Cast-iron, two-section box.

2. Top section with cover with "GAS" lettering.

3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.

4. Adjustable cast-iron extensions of length required for depth of bury.

5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.6 EARTHQUAKE VALVES

A. Earthquake Valves, Maximum Operating Pressure of 5 psig: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Vanguard Valves, Inc.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.

3. Maximum Operating Pressure: 5 psig.

5. Nitrile-rubber valve washer.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall mounting bracket with bubble level indicator.

B. Earthquake Valves, Maximum Operating Pressure of 60 psig: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Pacific Seismic Products, Inc.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.

3. Maximum Operating Pressure: 60 psig.

4. Cast-aluminum body with stainless-steel internal parts.


6. Valve position, open or closed, indicator.

7. Composition valve seat with clapper held by spring or magnet locking mechanism.

8. Level indicator.

9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.

2. Steel jacket and corrosion-resistant components.

3. Elevation compensator.

4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Actaris.
   b. American Meter Company.
   c. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
   d. Invensys.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.


5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.


8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Actaris.
   b. American Meter Company.
   c. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
   d. Invensys.
   e. Maxitrol Company.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 10 psig.


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Canadian Meter Company Inc.
   b. Eaton.
   c. Harper Wyman Co.
   d. Maxitrol Company.

5. Seat Disc: Nitrile rubber.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

2.8 SERVICE METERS

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Actaris.
   b. American Meter Company.
   c. Invensys.
   d. Itron Gas.

3. Connections: Steel threads.
6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet.
8. Meter Case and Index: Tamper resistant.
10. Maximum Inlet Pressure: 100 psig.
11. Pressure Loss: Maximum 0.5-inch wg or 2.0-inch wg.
12. Accuracy: Maximum plus or minus 1.0 percent.

B. Rotary-Type Service Meters: Comply with ANSI B109.3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. American Meter Company.
   b. Invensys.

6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet.
8. Tamper resistant.
10. Maximum Inlet Pressure: 100 psig.
11. Accuracy: Maximum plus or minus 2.0 percent.

C. Service-Meter Bars:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A.Y. McDonald Mfg. Co.
   b. American Meter Company.
   c. Lyall, R. W. & Company, Inc.
   d. Perfection Corporation.

2. Malleable- or cast-iron frame for supporting service meter.
3. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.
4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

D. Service-Meter Bypass Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. Williamson, T. D., Inc.

2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
3. Integral ball-check bypass valve.

2.9 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. A.Y. McDonald Mfg. Co.
      b. Central Plastics Company.
      c. Matco-Norca.
      d. WATTS.
   2. Description:
      b. Pressure Rating: 125 psig minimum at 180 deg F.
      c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      b. Central Plastics Company.
      c. Matco-Norca.
      d. WATTS.
   2. Description:
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. Pressure Rating: 125 psig minimum at 180 deg F.
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Advance Products & Systems, Inc.
2. Description:
   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

2.10 LABELING AND IDENTIFYING
   A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
   B. Inspect natural-gas piping according to NFPA 54 and the California Plumbing code (CPC) to determine that natural-gas utilization devices are turned off in piping section affected.
   C. Comply with NFPA 54 and the California Plumbing code (CPC) requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION
   A. Comply with NFPA 54 and the California Plumbing Code (CPC) for installation and purging of natural-gas piping.
   B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
      1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
   C. Install underground, PE, natural-gas piping according to ASTM D 2774.
   D. Steel Piping with Protective Coating:
1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:
1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the California Plumbing Code (CPC) for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped.
Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.

2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.

4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

   a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

   a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

   b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 “Escutcheons for Plumbing Piping.”

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within
72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

   1. Alkyd System: MPI EXT 5.1D.
      c. Topcoat: Exterior alkyd enamel semigloss or gloss.
      d. Color: Gray or yellow. Coordinate final color with Owner or Architect.

C. Paint exposed, interior metal piping inside Mechanical rooms, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except devices and components, with factory-applied paint or protective coating.

   1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      a. Prime Coat: Alkyd anticorrosive or Quick-drying alkyd metal primer.
      c. Topcoat: Interior latex semigloss or gloss.
      d. Color: Gray or yellow. Coordinate final color with Owner or Architect.

   2. Alkyd System: MPI INT 5.1E.
      a. Prime Coat: Alkyd anticorrosive or Quick-drying alkyd metal primer.
      c. Topcoat: Interior alkyd semigloss or gloss.
      d. Color: Gray or yellow. Coordinate final color with Owner or Architect.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig minimum, 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to NFPA 54, California Plumbing Code (CPC) and authorities having jurisdiction.
C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.14 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE
A. Underground natural-gas piping shall be the following:
   1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
B. Aboveground natural-gas piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.
C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
A. Aboveground, branch piping NPS 1 and smaller shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
B. Aboveground, distribution piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with steel welding fittings and welded joints.

C. Underground, below building, piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.18 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground:
   1. PE valves.
   2. NPS 2 and Smaller: Bronze plug valves.
   3. NPS 2-1/2 and Larger: Cast-iron, lubricated or nonlubricated plug valves.

3.19 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated or lubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Piping joining materials.
4. Encasement for piping.
5. Transition fittings.
6. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.
B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect, Construction Manager and/or Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Architect's, Construction Manager's and/or Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking “NSF-pw” on applicable piping.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type K water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.


D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.
4. Solder-joint or threaded ends.

F. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Elkhart Products Corporation.
   c. Mueller Industries, Inc.
   d. NIBCO INC.

2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.

3. Minimum 200-psig working-pressure rating at 250 deg F.

G. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Anvil International.
   b. Grinnell Mechanical Products.
   c. Shurjoint Piping Products USA Inc.
   d. Victaulic Company.

2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or ASTM B 584 bronze castings.

3. Mechanical Couplings for Grooved-End Copper Tubing:
   a. Copper-tube dimensions and design similar to AWWA C606.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.
   e. Minimum Pressure Rating: 300 psig.
2.3 **DUCTILE-IRON PIPE AND FITTINGS**

A. **Mechanical-Joint, Ductile-Iron Pipe:**
   1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. **Standard-Pattern, Mechanical-Joint Fittings:**
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. **Compact-Pattern, Mechanical-Joint Fittings:**
   1. AWWA C153/A21.53, ductile iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. **Plain-End, Ductile-Iron Pipe:** AWWA C151/A21.51.

E. **Appurtenances for Grooved-End, Ductile-Iron Pipe:**
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Shurjoint Piping Products USA Inc.
      b. Smith-Cooper International.
      c. Victaulic Company.
   2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
   3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
      a. AWWA C606 for ductile-iron-pipe dimensions.
      b. Ferrous housing sections.
      c. EPDM-rubber gaskets suitable for hot and cold water.
      d. Bolts and nuts.
      e. Minimum Pressure Rating:
         1) NPS 14 to NPS 18: 250 psig.
         2) NPS 20 to NPS 46: 150 psig.

2.4 **PIPING JOINING MATERIALS**

A. **Pipe-Flange Gasket Materials:**
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. **Metal, Pipe-Flange Bolts and Nuts:** ASME B18.2.1, carbon steel unless otherwise indicated.

C. **Solder Filler Metals:** ASTM B 32, lead-free alloys.
D. Flux: ASTM B 813, water flushable.
E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING
A. Standard: ASTM A 674 or AWWA C105/A21.5.
B. Form: Sheet or tube.
C. Color: Black or natural.

2.6 TRANSITION FITTINGS
A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.
B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
C. Sleeve-Type Transition Coupling: AWWA C219.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Dresser, Inc.
      c. JCM Industries, Inc.
      d. Smith-Blair, Inc.
D. Plastic-to-Metal Transition Fittings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      b. Harvel Plastics, Inc.
      c. Spears Manufacturing Company.
      d. Uponor.
   2. Description:
      a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
      b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
E. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Colonial Engineering, Inc.
   b. NIBCO INC.
   c. Spears Manufacturing Company.

2. Description:
   a. CPVC or PVC four-part union.
   b. Brass or stainless-steel threaded end.
   c. Solvent-cement-joint or threaded plastic end.
   d. Rubber O-ring.
   e. Union nut.

2.7 DIELLECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. A.Y. McDonald Mfg. Co.
      b. Central Plastics Company.
      c. Matco-Norca.
      d. Wilkins.
   3. Pressure Rating: 125 psig minimum at 180 deg F.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Central Plastics Company.
      b. Matco-Norca.
      c. WATTS.
      d. Wilkins.
   3. Factory-fabricated, bolted, companion-flange assembly.
   4. Pressure Rating: 125 psig minimum at 180 deg F.
   5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.

E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products.
   c. Matco-Norca.
   d. Precision Plumbing Products.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION
A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA’s "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

H. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

I. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.
3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
   Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.
   8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

J. Install supports for vertical stainless-steel piping every 15 feet.

K. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.
3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Repeat procedures if biological examination shows contamination.
   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
   2. Mechanical-joint, ductile-iron pipe; standard or compact-pattern, mechanical-joint fittings; and mechanical joints.
   3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:
   1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
   2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

G. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

H. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
   3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

J. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
   3. Stainless-steel Schedule 10 or Schedule 40 pipe, grooved-joint fittings, and grooved joints.

K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:
   1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
   2. Stainless-steel Schedule 10 or Schedule 40 pipe, grooved-joint fittings, and grooved joints.

3.13 VALVE SCHEDULE

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A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION
SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Vacuum breakers.
   2. Backflow preventers.
   5. Balancing valves.
   7. Strainers.
   8. Outlet boxes.
   9. Hose bibbs.
  10. Drain valves.
  12. Trap-seal primer valves.
  13. Trap-seal primer systems.
  14. Flexible connectors.

B. Related Requirements:
   1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
   2. Section 221116 "Domestic Water Piping" for water meters.
   3. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
   1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES
A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on applicable plastic piping components.

B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. FEBCO; A WATTS Brand.
      c. WATTS.
      d. Zurn Industries, LLC.
   3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   5. Inlet and Outlet Connections: Threaded.
   6. Finish: Rough bronze or Chrome plated.

B. Hose-Connection Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Cash Acme, A Division of Reliance Worldwide Corporation.
      c. WATTS.
      d. Zurn Industries, LLC.
   5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. FEBCO; A WATTS Brand.
      c. WATTS.
      d. Zurn Industries, LLC.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psig maximum, through middle third of flow range.
   5. Size: Refer to Plumbing design drawings.
   6. Design Flow Rate: Refer to Plumbing design drawings.
   7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
   8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings.
   9. Accessories: Refer to Plumbing design drawings.
      a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS
A. Reduced-Pressure-Principle Backflow Preventers:
   1. Manufacturers: Zurn Industries. No substitutions will be allowed.
   2. ¾” to 2”:
      a. Model: 975XL2
      c. Materials:
         1. Main Valve Body: Low Lead Cast Bronze ASTM B 584
         2. Access covers: Low Lead Cast Bronze ASTM B 584
      d. Design flow rate: Refer to Plumbing design drawings.
      e. Maximum working water pressure: 175 PSI
      f. Maximum working water temperature: 140°F
      g. End Connection: Threaded
   3. 2-1/2” to 10”:
      a. Model: 375AST
      c. Materials:
         1. Main Valve Body: 304L Stainless steel
         2. Access covers: 304L Stainless steel
      d. Design flow rate: Refer to Plumbing design drawings.
      e. Maximum working water pressure: 175 PSI
      f. Maximum working water temperature: 180°F
      g. End Connection:
         1. (Grooved for steel pipe) AWWA C606
         2. (Flanged) ANSI B16.1 Class 125
      h. Accessories:
         1. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

B. Backflow-Preventer Test Kits:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering
      products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. FEBCO; A WATTS Brand.
      c. WATTS.
      d. Zurn Industries, LLC.
   2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-
      procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering
      products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Cash Acme, A Division of Reliance Worldwide Corporation.
      c. WATTS.
      d. Zurn Industries, LLC.
   4. Size: Refer to Plumbing design drawings.
   5. Design Flow Rate: Refer to Plumbing design drawings.
   6. Design Inlet Pressure: Refer to Plumbing design drawings.
   7. Design Outlet Pressure Setting: Refer to Plumbing design drawings.
   8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior
      lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      b. ITT Corporation.
      c. NIBCO INC.
      d. TACO Comfort Solutions, Inc.
   2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
   3. Body: Brass or bronze.
   4. Size: Same as connected piping, but not larger than NPS 2.
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      b. ITT Corporation.
      c. NIBCO INC.
      d. WATTS.
   2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
   3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
      d. Red White Valve Corp.
   2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
   3. Pressure Rating: 400-psig minimum CWP.
   4. Size: NPS 2 or smaller.
   5. Body: Copper alloy.
   6. Port: Standard or full port.
   7. Ball: Chrome-plated brass.
   8. Seats and Seals: Replaceable.
   9. End Connections: Solder joint or threaded.

2.7 STRainers FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.020, 0.033, or 0.062 inch.
      b. Strainers NPS 2-1/2 to NPS 4: 0.045, 0.062 or 0.125 inch.
c. Strainers NPS 5 and Larger: 0.10, 0.125 or 0.25 inch.

2.8 OUTLET BOXES

A. Icemaker Outlet Boxes:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. IPS Corporation.
   b. LSP Products Group, Inc.
   c. Oatey.
   d. Plastic Oddities.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.9 HOSE BIBBS

A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Acorn Manufacturing.
   c. Woodford Manufacturing Company.
   d. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze, Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle or Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.

B. Gate-Valve-Type, Hose-End Drain Valves:
2. Pressure Rating: Class 125.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:
1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
5. Drain: NPS 1/8 side outlet with cap.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
1. Furnish as indicated on Plumbing Fixture Schedule or approved equal.

2.12 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:
1. Furnish as indicated on Plumbing Fixture Schedule or approved equal.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex-Weld, Inc.
4. Metraflex Company (The).

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig to 250 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig to 250 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.

3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve and downstream from fire sprinkler system supply. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.

E. Balancing Valves: Install in locations where they can easily be adjusted.

F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve and/or pump.

H. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

I. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

J. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.
   2. Reduced-pressure-principle backflow preventers.
   5. Primary, thermostatic, water mixing valves.
   8. Primary water tempering valves.
10. Supply-type, trap-seal primer valves.
11. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and/or double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      2. Hubless, cast-iron soil pipe and fittings.
      3. Ductile-iron pipe and fittings.
      4. Copper tube and fittings.
      5. Specialty pipe fittings.
   B. Related Requirements:
      1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.4 INFORMATIONAL SUBMITTALS
   A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
      1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
   B. Field quality-control reports.

1.5 FIELD CONDITIONS
   A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   2. Waste, Force-Main Piping: 50 psig, 100 psig or 150 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.


   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Conine Manufacturing Co., Inc.
      b. SE Sovent.

C. CISPI, Hubless-Piping Couplings:

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ANACO-Husky.
b. Fernco Inc.
c. Mission Rubber Company, LLC; a division of MCP Industries.
d. Tyler Pipe; a subsidiary of McWane Inc.


3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. Mission Rubber Company, LLC; a division of MCP Industries.
   d. Tyler Pipe; a subsidiary of McWane Inc.


3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. MG Piping Products Company.


3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot ends unless grooved or flanged ends are indicated.


3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.


C. Ductile-Iron, Grooved-End Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Anvil International.
b. Shurjoint Piping Products USA Inc.
c. Smith-Cooper International.
d. Victaulic Company.


3. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.6 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:
   2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   2. Unshielded, Nonpressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         2) Fernco Inc.
         3) Mission Rubber Company, LLC; a division of MCP Industries.
         4) Plastic Oddities.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

d. End Connections: Same size as and compatible with pipes to be joined.

e. Sleeve Materials:

   2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Nonpressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      2) Mission Rubber Company, LLC; a division of MCP Industries.


   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

   d. End Connections: Same size as and compatible with pipes to be joined.

4. Pressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      2) EBAA Iron, Inc.
      4) JCM Industries, Inc.


   c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

   d. Center-Sleeve Material: Manufacturer's standard, Carbon steel, Stainless steel, Ductile iron or Malleable iron.

   e. Gasket Material: Natural or synthetic rubber.

   f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. Dielectric Unions:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      1) A.Y. McDonald Mfg. Co.
      2) HART Industrial Unions, LLC.
      3) Matco-Norca.
      4) Zurn Industries, LLC.

   b. Description:
1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      1) Capitol Manufacturing Company.
      2) Central Plastics Company.
      3) Matco-Norca.
      4) Zurn Industries, LLC.

   b. Description:

      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: 125 psig minimum at 180 deg F.
      4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

3. Dielectric-Flange Insulating Kits:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      1) Advance Products & Systems, Inc.
      2) Calpico, Inc.
      3) Central Plastics Company.
      4) Pipeline Seal and Insulator, Inc.

   b. Description:

      1) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig.
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.
      5) Washers: Phenolic with steel backing washers.

4. Dielectric Nipples:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      1) Elster Perfection Corporation.
      2) Grinnell Mechanical Products.
      3) Matco-Norca.
      4) Precision Plumbing Products.

   b. Description:

      1) Standard: IAPMO PS 66.
      2) Electroplated steel nipple.
      3) Pressure Rating: 300 psig at 225 deg F.
      4) End Connections: Male threaded or grooved.
      5) Lining: Inert and noncorrosive, propylene.
2.8 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
   a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
   a. Reducing size of waste piping in direction of flow is prohibited.

L. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 or 2 percent downward in direction of flow for piping NPS 4 and larger.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install steel piping according to applicable plumbing code.

P. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

R. Install engineered soil and waste and vent piping systems as follows:
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

S. Install underground, ductile-iron, force-main piping according to AWWA C600.
1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

T. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
U. Install force mains at elevations indicated.

V. Plumbing Specialties:
   1. Install backwater valves in sanitary waster gravity-flow piping.
      a. Comply with requirements for backwater valves specified in Section 221319
         "Sanitary Waste Piping Specialties."
   2. Install cleanouts at grade and extend to where building sanitary drains connect to building
      sanitary sewers in sanitary waste gravity-flow piping.
      a. Install cleanout fitting with closure plug inside the building in sanitary drainage
         force-main piping.
      b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary
         Waste Piping Specialties."
   3. Install drains in sanitary waste gravity-flow piping.
      a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste
         Piping Specialties."

W. Do not enclose, cover, or put piping into operation until it is inspected and approved by
   authorities having jurisdiction.

X. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve
      Seals for Plumbing Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve
      Seals for Plumbing Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for
      Plumbing Piping."

3.3 JOINT CONSTRUCTION

   A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron
      Soil Pipe and Fittings Handbook" for compression joints.

   B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil

   C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and
      Fittings Handbook" for hubless-piping coupling joints.

   D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
      1. Cut threads full and clean using sharp dies.
      2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and
         valves as follows:
a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
c. Do not use pipe sections that have cracked or open welds.

e. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

f. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

g. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

h. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

a. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Waste Drainage Piping: Unshielded or Shielded, nonpressure transition couplings.
   4. In Underground Force Main Piping:
      a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
      b. NPS 2 and Larger: Pressure transition couplings.

b. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
   3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.
   4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

a. Comply with requirements in Section 220523 "General Duty Valves for Plumbing Piping" for valve installation requirements.

b. Shutoff Valves:
   1. Install shutoff valve on each sewage pump discharge.
   2. Install gate or full-port ball valve for piping NPS 2 and smaller.
   3. Install gate valve for piping NPS 2-1/2 and larger.

c. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

d. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
   2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." and Section 220548 "Vibration Controls for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
   Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
   8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 2: 84 inches with 3/8-inch rod.
   2. NPS 3: 96 inches with 1/2-inch rod.
   3. NPS 4: 108 inches with 1/2-inch rod.
   4. NPS 6: 10 feet with 5/8-inch rod.

K. Install supports for vertical stainless-steel piping every 10 feet.

L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

M. Install supports for vertical copper tubing every 10 feet.

N. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
   6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
   7. Equipment: Connect waste piping as indicated.
      a. Provide shutoff valve if indicated and union for each connection.
      b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main.
   2. Sewage Pump: To sewage pump discharge.
E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION
   A. Identify exposed sanitary waste and vent piping.
   B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL
   A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
      1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
      1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
         a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
      2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
         a. Expose work that was covered or concealed before it was tested.
      3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
         a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
         b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
         c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
   a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
   b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
   c. Air pressure must remain constant without introducing additional air throughout period of inspection.
   d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
   a. Isolate test source and allow to stand for four hours.
   b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.

2. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.

3. Copper Type DWV tube, copper drainage fittings, and soldered joints.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
3. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
3. Stainless-steel pipe and fittings gaskets, and gasketed joints.
4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
   a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

E. Aboveground, vent piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.

F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.

G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; coupled joints.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.
3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

J. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:

1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, grooved-joint piping and grooved joints.
4. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

K. Underground sanitary-sewage force mains NPS 5 and larger shall be any of the following:

1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, grooved-joint piping and grooved joints.
4. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Backwater valves.
   2. Cleanouts.
   3. Roof flashing assemblies.
   4. Through-penetration firestop assemblies.
   5. Miscellaneous sanitary drainage piping specialties.
   6. FOG disposal systems.
   7. Floor drains.
   8. Floor sinks.
  10. Channel drainage systems.

B. Related Requirements:
   1. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

B. FOG: Fats, oils, and greases.
C. FRP: Fiberglass-reinforced plastic.
D. HDPE: High-density polyethylene.
E. PE: Polyethylene.
F. PP: Polypropylene.
G. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1.5 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS
   A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
   B. Comply with NSF 14 for plastic sanitary waste piping specialty components.
   C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.
   D. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

2.2 CLEANOUTS
   A. Cast-Iron Exposed Cleanouts:
      1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         b. MIFAB, Inc.
         c. WATTS.
         d. Zurn Industries, LLC.
      2. Standard: ASME A112.36.2M.
      3. Size: Same as connected drainage piping
      4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
      5. Closure: Countersunk, brass plug.
      6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

   B. Cast-Iron Exposed Floor Cleanouts:
      1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         b. Josam Company.
         c. WATTS.
         d. Zurn Industries, LLC.
      2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
      3. Size: Same as connected branch.
      4. Type: Threaded, adjustable housing.
      5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with setscrews or other device.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Light.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. MIFAB, Inc.
   c. WATTS.
   d. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.


2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch to 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:
1. Description: Counterflash-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Expansion Joints:
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.4 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. MIFAB, Inc.
   c. Wade; a subsidiary of McWane Inc.
   d. WATTS.
2. Standard: ASME A112.6.3.
5. Anchor Flange: Required.
7. Outlet: Bottom.
8. Top or Strainer Material: Nickel bronze.
10. Top Shape: Round.
11. Dimension of strainer: 5-in diameter.
12. Top Loading Classification: Light Duty
14. Trap Pattern: Standard P-trap
15. Trap Features: Trap-seal primer valve drain connection.

2.5 FLOOR SINKS

A. Cast-Iron Floor Sinks:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   b. MIFAB, Inc.
   c. Wade; a subsidiary of McWane Inc.
   d. Watts; a Watts Water Technologies company.
5. Anchor Flange: Not required.
6. Clamping Device: Not required.
7. Outlet: Bottom, no-hub connection.
8. Coating on Interior Surfaces: Acid-resistant enamel.
10. Internal Strainer: Dome.
12. Top Grate Material: Cast iron, loose.
14. Top Shape: Square.
15. Dimensions of Top Grate: 9-in square half grate.
16. Top Loading Classification: No traffic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:
   1. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.
   5. At each horizontal drainage pipe upper terminal.
   6. Above each urinal

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

G. Assemble open drain fittings and install with top of hub 2 inches above floor.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install vent caps on each vent pipe passing through roof.

L. Install wood-blocking reinforcement for wall-mounting-type specialties.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

N. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4- inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1- inch total depression.
   4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
      a. Maintain integrity of waterproof membranes where penetrated.
   5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

O. Install trench drains at low points of surface areas to be drained.
   1. Set grates of drains flush with finished surface, unless otherwise indicated.

P. Install open drain fittings with top of hub 2 inches above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

F. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
3.3 FLASHING INSTALLATION

A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
   1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections, and prepare test reports.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. ABS pipe and fittings.
   2. Specialty pipe and fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: For roof drainage system. Include plan and details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS

2.1 ABS PIPE AND FITTINGS


B. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.


D. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 EXECUTION

3.1 PIPING INSTALLATION
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
   1. Do not change direction of flow more than 90 degrees.
   2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of drainage piping in direction of flow is prohibited.

L. Install piping at the following minimum slopes unless otherwise indicated:
   1. Building Storm Drain: Slope pipe 1/2” per 1’-0” downward in direction of flow for piping
   2. Horizontal Storm Drainage Piping: Slope pipe 1/2” per 1’-0” downward in direction of flow for piping.

M. Install aboveground ABS piping according to ASTM D 2661.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendices.

B. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
   a. Provide rigid sway bracing for pipe and fittings and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: nonpressure transition couplings.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install pipe hangers for horizontal piping in noncorrosive environments.
2. Install pipe hangers for horizontal piping in corrosive environments.
3. Install support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. MSS Type 1, adjustable, steel clevis hangers.
7. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
2. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
3. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

G. Install supports for vertical piping every 48 inches

H. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:
   a. Test storm drainage piping on completion of roughing-in.
   b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.
   C. Piping will be considered defective if it does not pass tests and inspections.
   D. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION
   A. Clean interior of piping. Remove dirt and debris as work progresses.
   B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
   C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE
   A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
   B. Aboveground storm drainage piping shall be
      1. ABS pipe, ABS socket fittings, and solvent-cemented joints.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Metal roof drains.
   2. Miscellaneous storm drainage piping specialties.
   3. Cleanouts.

B. Related Requirements:
   1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      b. MIFAB, Inc.
      c. Zurn
      d. WATTS.
3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Atmospheric, gas-fired, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS
A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS
A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of commercial, gas-fired and gas-fired, tankless domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
D. Source quality-control reports.
E. Field quality-control reports.
F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
   1. Comply with efficiency requirements in ASHRAE 189.1, which supersede requirements in ASHRAE/IESNA 90.1.
C. ASME Compliance:
   1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.8 COORDINATION
A. Coordinate sizes and locations of actual equipment provided.

1.9 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Periods: From date of Substantial Completion.
      a. Commercial Gas-Fired, Storage, Domestic-Water Heaters:
         1) Storage Tank: Three years.
PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Rheem Manufacturing Company.
   c. Smith, A. O. Corporation.


A. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221023 "Facility Natural-Gas Piping."

B. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor sink.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters.
Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for fuel-oil piping specified in Section 221023 "Facility Fuel-Oil Piping."

C. Comply with requirements for gas piping specified in Section 221023 "Facility Natural-Gas Piping."

D. Drawings indicate general arrangement of piping, fittings, and specialties.

E. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

4. Test and adjust controls and safety systems. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.
3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage and gas-fired, tankless, domestic-water heaters.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Water closet Flushometer valves and tanks.
3. Toilet seats.
4. Urinals.
5. Urinal Flushometer valves.
7. Lavatory Faucets.
8. Service sinks.
11. Sink faucets.
12. Shower faucets.
15. Lavatory and Sink Supply Fittings.
16. Lavatory and Sink Waste Fittings.
17. Grout.

B. Related Requirements:

1. Section 224500 "Emergency Plumbing Fixtures" for Eyewash and shower units.
2. Section 224713 "Drinking Fountains" for drinking fountain units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics (where applicable), and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For water consumption.

C. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.
1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fixtures, faucets, flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than five of each type.

2. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

3. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 – PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud.

1. Manufacturer: Kohler “Kingston” model K-4325 or approved equal.

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following; American Standard, Sloan Valve or Zurn Industries.

3. Bowl:

   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Style: Flushometer valve.
   e. Height: Standard.
   f. Rim Contour: Elongated.
   g. Water Consumption: 1.28 gal. per flush.
   h. Spud Size and Location: NPS 1-1/2; top.

4. Flushometer Valve: See below.

5. Toilet Seat: See below.


7. Water-Closet Mounting Height: Standard or Accessible or per Architectural drawings.

2.2 WATER CLOSET FLUSHOMETER VALVES

A. Electronic Flushometer Valves:

1. Manufacturer: Sloan “Royal Optima” model 111-1.28-ESS-TMO or approved equal.

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following; American Standard, Sloan Valve or Zurn Industries.


4. Type: Diaphragm.

7. Material: Brass body with corrosion-resistant components.
8. Exposed Flushometer-Valve Finish: Chrome plated.
10. Style: Exposed.
11. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
12. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
13. Consumption: 1.28 gal. per flush.

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturer: Kohler K-4731-C or approved equal.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following; Bemis Manufacturing, Church Seats or American Standard.
5. Type: Commercial, Heavy duty.

2.4 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, Hybrid with automatic drain rinse.

1. Manufacturer: Kohler Bardon K-4991-ET or approved equal.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following; American Standard, Sloan Valve or Zurn Industries.
3. Fixture:
   b. Type: Hybrid, Washout.
   c. Material: Vitreous china.
   d. Strainer or Trapway: Manufacturer's standard strainer.
   e. Water Consumption: Water saving.
   f. Spud Size and Location: NPS 3/4; top.
   g. Outlet Size and Location: NPS 2; back.
   h. Color: White.
5. Waste Fitting:
   b. Size: NPS 2.
6. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.
7. Urinal Mounting Height: Standard or Accessible or per Architectural drawings.

2.5 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Rectangular, vitreous china, undercounter mounted.
   1. Manufacturer: Kohler K-2882 or approved equal.
   2. Faucet: See Automatically Operated Lavatory Faucets

2.6 AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.
B. Lavatory Faucets: Automatic-type, hard-wired, operated, mixing type
   1. Manufacturer: Dyson Air Blade Model WD04 or approved equal.

2.7 SERVICE SINKS

A. Service Sinks: Enamel, cast iron, trap standard mounted.
   1. Manufacturer: Ceco Model 871 or approved equal.
   2. Faucet: Manufacturer: Chicago 897-CP or approved equal.

2.8 BREAK ROOM SINK

A. 18 gauge Stainless steel, wall mounted.
   1. Manufacturer: Kohler K-3894 or approved equal.
   2. Faucet: Kohler K-10433

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
B. Examine walls, floors and counters for suitable conditions where fixtures will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:
   1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Water-Closet Support Installation:
   1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
   2. Use carrier supports with waste-fitting assembly and seal.
   3. Install waste-fitting seals; and attach to support.
   4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Water-Closet Flushometer-Valve Installation:
   1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
   4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Urinal Installation:
   1. Install urinals level and plumb according to roughing-in drawings.
   2. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
   3. Install trap-seal liquid in waterless urinals.

F. Urinal Support Installation:
   1. Install supports, affixed to building substrate, for wall-hung urinals.
   2. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

G. Urinal Flushometer-Valve Installation:
   1. Install flushometer-valve water-supply fitting on each supply to each urinal.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

H. Install lavatories, sinks and showers level and plumb according to roughing-in drawings.

I. Install supports, affixed to building substrate, for wall-mounted lavatories and sinks.

J. Install accessible wall-mounted lavatories and sinks at accessible mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

K. Set floor-mounted sinks, shower receptors or shower basins in leveling bed of cement grout.

L. Install shower flow-control fittings with specified maximum flow rates in shower arms.

M. Assemble shower components according to manufacturers' written instructions.

N. Install water-supply piping with stop on each supply to each fixture faucet.
   1. Exception: Use ball or gate valves if supply stops are not specified with fixture or integral with fixture. Comply with valve requirements specified in Section 220523 “General Duty Valves for Plumbing Piping.”
   2. Install stops in locations where they can be easily reached for operation.
O. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

P. Seal joints between fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

Q. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, risers, traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in all battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of fixtures, inspect and repair damaged finishes.

B. Clean fixtures, faucets, flush valves and fittings with manufacturers’ recommended cleaning methods and materials.

C. Install protective covering for installed fixtures and fittings.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION
SECTION 22 42 46
COMBINATION WATER TAP AND ELECTRIC HAND DRYER UNITS

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.2 SECTION INCLUDES

A. Combination electric hand dryer and water tap units.

1.3 RELATED SECTIONS

A. Section 22 11 16 - Domestic Water Piping: Water supply to unit.
B. Section 22 42 00 - Commercial Plumbing Fixtures: Sinks and water temperature control units.
C. Division 26 - Electrical: Electrical systems and components.

1.4 SUBMITTALS

A. Product Data: Provide construction details, dimensions, anchoring and mounting requirements, material and finish descriptions, electrical requirements, and manufacturer’s warranty.
B. Operation and Maintenance Data: Provide for combination water tap and electric hand dryer units to include in maintenance manuals.
C. Warranty: Provide sample of manufacturer’s standard warranty for parts and labor.

1.5 QUALITY ASSURANCE

A. Product Certifications:
   1. ETL listed in accordance with UL 507.
   2. Approved by HACCP International as hygienically safe for use in the food and beverage industry.
   3. cETL listed and labeled to comply with the requirements of the Standard(s) for Safety of Household and Similar Electrical Appliances (CAN/CSA-E60335-1).
   4. cETL listed and labeled to comply with the requirements of the Standard(s) for Safety of Household and Similar Electrical Appliances - Particular Requirements for Skin or Hair Care (CAN/CSA-E60335-2-23).
   5. ASME A112.18.1/CSA B125.1 Plumbing Supply Fittings compliant.
   6. ANSI A117.1 Accessible and Usable Buildings and Facilities compliant.
   7. CSA B651 Accessible Design for the Built Environment compliant.
   8. 10 CFR 429.28 Faucets compliant.
B. Electrical Components, Devices, and Accessories: List and labeled in accordance with NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE AND HANDLING
A. Deliver, store, and handle combination water tap and electric hand dryer units in manufacturer's protective packaging.

B. Store combination units off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate locations of combination water tap and electric hand dryer units with other work to prevent interference with clearances required for access, and for proper installation, adjustment, operation, cleaning, and servicing of combination electric hand dryers and water taps.

B. Coordinate units with type of sinks specified in Section 22 42 00 to ensure compatibility. Verify that plugs are not installed in the sinks.

1.8 WARRANTY

A. Manufacturer's Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective combination water tap and electric hand dryer units components and labor within specified warranty period.

1. Warranty Period: Five (5) years limited for labor and five (5) years for parts.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the combination electric hand dryer and water units Dyson Airblade Wash+Dry hand dryer manufactured by Dyson Inc., 1330 W. Fulton St., Floor 5, Chicago, IL 60607; 888-397-6622, www.dyson.com/Airblade or comparable product acceptable to the Architect.

2.2 COMBINATION WATER TAP AND ELECTRIC HAND DRYER UNITS

A. Combination Water Tap and Electric Hand Dryer Units: The combination water tap and electric hand dryer Dyson Airblade Wash+Dry hand dryer (Model WD04 Short); Item No. [247659-01 (LV)] [247908-01 (HV)].

1. Mounting: Surface mounted on sink.
2. Tap Construction: 304 Grade stainless steel with brushed finish.
3. Under Counter Motor Assembly Construction: Main unit constructed of molded ABS, PC, and PP.
4. Exterior Screw Type: Torx T15.
5. Water Ingress Protection Rating: Conform to IP35.
6. Filtration: 99.97 percent particulate efficiency HEPA filter with anti-microbial coating.
7. Operation: Touch-free infra-red activation.
   b. Airspeed at nozzle: [331 mph (533 km/h)] [341 mph (549 km/h)].
   c. Operating Airflow: Up to 5.5 gallons/second (21 liters/second).
   d. Rated Operating Noise Power: [80 db] [81 db]
   e. Motor: Dyson Digital Motor (DDM), V4 switched reluctance brushless DC type; 81,000 rpm motor speed.
f. Electrical Requirements: [110-127 V AC, 12 A, 1000 W] [200-240 V AC, 12 A, 1000 W].
g. Operating Temperature Range: 32º - 104º F (0º - 40º C).
h. Standby Power Consumption: Less than 0.5 W.

8. Water Operation:
   a. Water Flow Rate: 0.5 gallons/minute.
   b. Tap Aerator: 0.5 gallon/minute aerator outlet.
   c. Tap Water Auto-Flush: Activates for 60 seconds after 24 hours of inactivity to flush standing water and help reduce bacteria growth.
   d. Tap Power Supply: Mains supply.
   e. Water Temperature Control: Thermostatic mixer not provided.
   f. Water Pressure Required: 14.5 to 116 psi.

2.3 INSTALLATION
   A. Install units in accordance with manufacturer’s written instructions, using fasteners appropriate to substrate indicated and recommended by manufacturer. Install units level, plumb, and firmly anchored in locations indicated.

2.4 CLEANING AND PROTECTION
   A. Adjust units for smooth operation. Replace damaged or defective components.
   B. Remove protective coverings from finished surfaces.
   C. Clean exposed surfaces using materials and methods recommended by manufacturer.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes drinking fountains and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS WATER COOLERS

A. Drinking Fountains:
   1. Manufacturers: Manufacturer: Elkay Model LZSTL8WSSP Elkay enhanced EZH2O Bottle Filling Station and Versatile bi-level ADA cooler Filter 8 GPH or approved equal.

2.2 SUPPORTS

A. Carrier:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Elkay
   2. Standard: ASME A112.6.1M.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set pedestal drinking fountains on floor.

C. Install recessed drinking fountains secured to wood blocking in wall construction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General Duty Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.
3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer’s written instructions.

C. Provide protective covering for installed fixtures.

D.

E. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SCOPE

A. Basic mechanical requirements specifically applicable to Division 23 and 33 Sections.

B. Work includes but is not necessarily limited to the following:

1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:

   a. Heating, ventilating and air conditioning systems and equipment
   b. Testing, adjusting and balancing

1.2 DRAWINGS AND SPECIFICATIONS

A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers’ recommendations, and in a first class manner.

B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.

C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Owner has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Owner’s Representative.

D. Contract Documents are in part diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow these drawings in laying out the equipment, piping and ductwork. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.

E. Follow dimensions without regard to scale. Where no figures or notations are given, the Plans shall be followed.

1.3 UTILITIES

A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.
1.4 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS

A. Meet requirements of all state codes having jurisdiction.

B. State of California Code of Regulations:
   1. Title 8, Industrial Relations
   2. Title 19, State Fire Marshal Regulations
   3. Current California Building Code (CBC), Title 24, Part 2
   4. Current California Electrical Code, Title 24, Part 3
   5. Current California Mechanical Code, Title 24, Part 4
   6. Current California Plumbing Code, Title 24, Part 5
   7. Current California Energy Code, Title 24, Part 6
   8. Current California Fire Code, Title 24, Part 9
   9. Current California Standards Code, Title 24, Part 12

C. Additional Referenced Standards:
   1. AABC Associated Air Balance Council
   2. AMCA Air Moving and Conditioning Association
   3. ARI Air-Conditioning and Refrigeration Institute
   4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
   5. ASME American Society of Mechanical Engineers
   6. ASTM American Society for Testing and Materials
   7. NEMA National Electrical Manufacturer’s Association
   8. NFPA National Fire Protection Association Standards
   9. PDI Plumbing and Drainage Institute
   10. UL Underwriters Laboratories

D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Owner’s Representative.

E. Obtain permits, and request inspections from authority having jurisdiction.

1.5 PROJECT AND SITE CONDITIONS

A. The arrangement of and connection to equipment shown on the Drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.

B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.

C. Examine site related work and surfaces before starting work of any Section.

D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.

E. Prepare shop drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Owner’s Representative before proceeding.
1.6 COOPERATION WITH WORK UNDER OTHER DIVISIONS

A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.

B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.

C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.

D. Make such progress in the Work to not delay work of other trades.

E. Mechanical Work shall have precedence over the other in the following sequence:
   1. Soil and waste piping
   2. Hydronic piping
   3. Ductwork
   4. Domestic water piping
   5. Fire sprinkler piping

1.7 DISCREPANCIES

A. The Contractor shall check all Drawings furnished him immediately upon their receipt and shall promptly notify the Owner’s Representative of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Piping and instrumentation diagrams shall in general govern floor plans and sections. Large-scale drawings shall in general govern small-scale drawings.

B. Where requirements between Drawings and Specifications conflict, the more restrictive provisions shall apply.

C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Owner’s Representative for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Owner Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

1.8 CHANGES

A. The Contractor shall be responsible to make and obtain approval from the Owner’s Representative for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.9 SUBMITTALS

A. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.

B. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.

C. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
D. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Owner’s Representative.

E. Submit all Division 23 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.

F. Shop Drawings:

1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.
4. Whenever more than one (1) manufacturer’s product is specified, the first named product is the basis of design used in the Drawings and the use of alternate-named manufacturer’s products or substitutes may require modifications to the design.
5. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Owner’s Representative bearing the Owner’s Representative stamp of “Reviewed”. All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Owner’s Representative without additional compensation.
6. Manufacturer’s Data: For each manufactured item, provide current manufacturer’s descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
7. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or American Water Works Association (AWWA), submit proof of such conformance to the Owner Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Owner Representative. The certificate shall state that the item has been tested in accordance with the specified organization’s test methods and that the item conforms to the specified organization’s standard.
8. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
9. Certificates of Compliance or Conformance: Submit manufacturer’s certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer’s certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as “as good as”; or “achieve the same end use and results as materials formulated in accordance with the referenced publications”; or “equal or exceed the service and performance of the specified material.” Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer’s letterhead and shall be signed by the manufacturer’s official authorized to sign certificates of compliance or conformance.

1.10 PROJECT RECORD DOCUMENTS

A. All changes, deviations and information recorded on the “Project Record Drawings” set during Construction shall be redrafted onto the latest version of AutoCAD or Revit, where applicable.

B. Submit completed shop drawings to the Owner prior to completion in AutoCAD format.
C. Contractor hand marked or drafted redlined “Project Record Drawings” will not be accepted.

1.11 OPERATING INSTRUCTIONS
A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.12 MANUFACTURER’S RECOMMENDATIONS
A. Where installation procedures or any part thereof are required to be in accordance with manufacturer’s recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.13 DELIVERY AND STORAGE
A. Handle, store, and protect equipment and materials in accordance with the manufacturer’s recommendations and with the requirements of NFPA 70B P, Appendix I, titled “Equipment Storage and Maintenance During Construction.” Replace damaged or defective items with new items.

1.14 GUARANTEE
A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.

B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed.

1.15 COMMISSIONING
A. Division 23 will be responsible to carry out the commissioning requirements.

B. Management:
   1. The Commissioning Agent (CA) is hired directly by the Owner.
   2. The CA directs and coordinates the commissioning activities and the reports to the Owner’s Representative.
   3. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
   4. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the Owner Representative.
   5. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.

C. Commissioning requires the participation of Division 23 Mechanical Contractor to work to ensure that all systems are operating in a manner consistent with the Design Intent.
D. The mechanical contractor is responsible for assisting the commissioning agent throughout the entire commissioning process. The work is not complete until the commissioning agent and the Owner Representative has signed off on the commissioned systems.

1.16 COMMISSIONING RESPONSIBILITIES

A. Mechanical Contractor: The commissioning responsibilities applicable to the mechanical contractor are as follows (all references apply to commissioned equipment only):

1. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the Owner Representative.
2. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
3. General Contractor shall attend a commissioning kickoff meeting and other meetings necessary to facilitate the commissioning process.
4. General Contractor shall provide the Commissioning Provider with normal cut sheets and shop drawing submittals of commissioned equipment.
5. General Contractor shall provide additional requested documentation, prior to normal O&M manual submittals, to the Commissioning Provider for development of start-up and functional testing procedures.
   a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Provider.
   b. The Commissioning Provider may request further documentation necessary for the commissioning process.

6. General Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the Commissioning Provider for review.
7. Sub-Contractors and design engineers shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
8. General Contractor shall provide limited assistance to the Commissioning Provider in preparing the specific functional performance test procedures. Sub-Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
9. General Contractor shall develop a full start-up and initial checkout plan using manufacturer’s start-up procedures and the pre-functional checklists from the Commissioning Provider for all commissioned equipment. Submit to Commissioning Provider for review prior to startup.
10. During the startup and initial checkout process, execute the mechanical related portions of the pre-functional checklists for all commissioned equipment.
11. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the Commissioning Provider.
12. Address current Engineer of Record punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
13. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
14. Provide skilled technicians to perform functional performance testing under the direction of the Commissioning Provider. Assist the Commissioning Provider in interpreting the monitoring data, as necessary.
15. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Provider, Owner’s Representative and Engineer of Record and retest the equipment.
16. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
17. During construction, maintain as-built redline drawings for all drawings and final CAD as-buils for contractor-generated coordination drawings. Update after completion of commissioning.
18. Provide training of the Owner Representative’s operating staff using expert qualified personnel, as specified.
19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
20. Execute any deferred functional performance testing, witnessed by the Commissioning Provider, according to the specifications.
21. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Mechanical Contractor. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all HVAC equipment, except for the building automation control system.
2. Assist and cooperate with the TAB contractor and Commissioning Provider by:
   a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
   b. Including cost of sheaves and belts that may be required by TAB.
   c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved plug.
   d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
3. Install a P/T plug at each water sensor, which is an input point to the control system.
4. List and clearly identify on the as-built drawings the locations of all air-flow stations.
5. Prepare a preliminary schedule for pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the Commissioning Provider. Update the schedule as appropriate.
6. Notify the Owner’s Representative when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the Owner’s Representative or Commissioning Provider, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the Commissioning Provider has the scheduling information needed to efficiently execute the commissioning process.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 GENERAL
A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Owner’s Representative.

3.2 WORK RESPONSIBILITIES

A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.

B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.

D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.

F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Owner immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Owner.

G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Owner and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.

H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.

I. Replace or repair, without additional compensation, any Work, which, in the opinion of the Owner, does not comply with these requirements.

3.3 PAINTING

A. Refer to Division 09 for additional requirements.

B. Factory Applied:

1. Mechanical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.

2. Refer to individual sections of this Division for more stringent requirements.
C. Field Applied:

1. Paint all mechanical equipment as required to touch up, to match finish on other 
equipment in adjacent spaces or to meet safety criteria.
2. Paint all exposed, uninsulated mechanical piping, valves, supports, hangers and 
appurtenances. Provide minimum 5 mils dry film thickness.
3. Paint ductwork flat black that are visible behind air outlets and inlets.
4. Paint all exposed and rooftop ductwork, roof mounted mechanical equipment, ductwork 
supports, hangers and appurtenances.
5. Paint shall be a high performance polyurethane enamel coating system.
   a. Acceptable paint manufacturers include Ameron, Tnemec or engineer approved 
equal.
   b. Acceptable primer manufacturers include Ameron Amershield VOC, Tnemec's 
      Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen or equal.
   c. Provide minimum 5 mils dry film thickness.

3.4 COMMISSIONING TRAINING OF OWNER’S REPRESENTATIVE PERSONNEL

A. The General Contractor shall be responsible for training coordination and scheduling and 
ultimately to ensure that training is completed.

B. The Commissioning Provider shall be responsible for reviewing the content and adequacy of the 
training of Owner’s Representative personnel for commissioned equipment.

C. Mechanical Contractor. The mechanical contractor shall have the following training 
responsibilities:

1. Provide the Commissioning Provider and A/E with a training plan at least two weeks 
before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the 
understanding of the systems and the operation and maintenance of each piece of HVAC 
equipment.
3. Training shall normally start with classroom sessions followed by hands-on training on 
each piece of equipment, which shall illustrate the various modes of operation, including 
startup, shutdown, fire/smoke alarm, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the 
requirements of the O&M manual or sequence of operations, the system will be repaired or 
adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer’s representative shall provide the instructions on 
each major piece of equipment. This person may be the start-up technician for the piece of 
equipment, the installing contractor or manufacturer’s representative. Practical building 
operating expertise as well as in-depth knowledge of all modes of operation of the 
specific piece of equipment are required. More than one party may be required to 
execute the training.
6. The controls contractor shall attend sessions other than the controls training, as 
requested, to discuss the interaction of the controls system as it relates to the equipment 
being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and 
maintenance manual and illustrate whenever possible the use of the O&M manuals for 
reference.
8. Training shall include:
   a. Use of the printed installation, operation and maintenance instruction material 
      included in the O&M manuals.
b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.

c. Discussion of relevant health and safety issues and concerns.

d. Discussion of warranties and guarantees.

e. Common troubleshooting problems and solutions.

f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

g. Discussion of any peculiarities of equipment installation or operation.

h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for all pieces of equipment.

10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

11. Training shall occur after functional testing is complete, unless approved otherwise by the Owner’s Representative.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Dielectric fittings.
   3. Escutcheons.
   4. Equipment installation requirements common to equipment sections.
   5. Concrete bases.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Welding certificates.

B. Product Information for approval before purchase

C. Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Pipe Flange Nuts and Bolts: Provide 304 stainless steel bolts, washers and nuts for mechanical rooms, underground piping and in humid areas.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.


2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 150-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 150-psig minimum working pressure at 225 deg F.

2.4 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION
A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
A. Comply with NEMA MG 1 unless otherwise indicated.
B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS
A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS
A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Premium efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Multispeed Motors: Separate winding for each speed.
F.  Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G.  Temperature Rise: Match insulation rating.

H.  Insulation: Class F.

I.  Code Letter Designation:

1.  Motors 15 HP and Larger: NEMA starting Code F or Code G.
2.  Motors smaller than 15 HP: Manufacturer's standard starting characteristic.

J.  Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A.  Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B.  Motors Used with Variable Frequency Controllers:

1.  Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2.  Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3.  Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4.  Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C.  Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A.  Motor shall be an electronic commutation (EC) motor specifically designed for HVAC applications. AC induction type motors are not acceptable.

B.  Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase.

C.  Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown).

D.  Motor shall be a minimum of 85% efficient at all speeds.
1.1 RELATED DOCUMENTS:
   A. Electrical General Requirements are part of this section and apply to this section as full as if repeated herein.
   B. Mechanical General Requirements, specification sections for Pumps

1.2 SCOPE
   A. Furnish labor and related materials, appliances, tools and equipment necessary for and incident to performing all operations in connection with furnishing, delivery, installation, and start up of Variable Frequency Drive.

1.3 QUALITY ASSURANCE AND STANDARDS
   A. The latest revision of the standards listed below form an integral part of this specification:
      B. American National Standard Institute (ANSI).
         1. Institute of Electrical and Electronic Engineers, Inc. (IEEE).
         2. National Electrical Manufacturer’s Association (NEMA)
         3. National Fire Protection Association (NFPA)
         5. Underwriters Laboratories (UL)
   C. Manufacturer:
      D. Shall not have less than ten (10) years of experience in the manufacture of variable frequency drives similar to the type and size specified on this project.
         1. Shall be ISO-9002 certified.
         2. Manufacturer shall have nationwide technical support organization available 24 hours a day from a toll-free telephone number. Capabilities shall include factory coordinated start-up service and on-site training of customer personnel.
         3. Shall have a local service facility located within (50) miles radius of the project site and be able to provide field service with twenty (24) hours.

1.4 SUBMITTALS
   A. Technical cut-sheets, product data on adjustable frequency controllers, relays, pilot devices and switching and over-current protective devices.
   B. Factory Test Reports.
   C. Manufacturer’s installation and operating instructions.
   D. Start-up service report.

1.5 MANUFACTURERS:
1.6 WARRANTY

A. The drive manufacturer shall guarantee the operation of the drive against failure due to defects a minimum period of 24 months from the date of acceptance by Owner. Warranty shall cover all labor and parts required to repair/replace on site.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The alternating current variable speed drive shall include the microprocessor based variable controller, the required signal logic and control. The drive component specified including the variable frequency controller and its associated microprocessor control system shall be of the same manufacture. Coordinate with pump, cooling tower, fan or air handling unit supplier to ensure compatibility between drive and AC motors.

B. The drive shall be UL listed and CSA approved, and shall comply with all applicable requirements of the latest standard of ANSI, IEEE and NEMA.

2.2 VARIABLE FREQUENCY DRIVE

A. Standard Features

B. Main input power shall be 400V – 460V/60Hz.

1. The drive shall have a tolerance for voltage ± 10% and frequency ± 2Hz. Overload current shall be 100% continuous and 110% for 1 minute.

2. Interrupting rating (AIC): 65,000 AIC (RMS symmetrical) unless otherwise noted. The use of input fuses to achieve this rating shall not be acceptable. Contractor to verify the rating from the short circuit study prior to furnishing submittal.

3. Automatic cooling fan control based on heat sink temperature for extended fan life.

4. Shall have a built-in control system for commercial power/standby power switching.

5. Shall have an adjustable retry function after a fault, both number of attempts (at least 10) and time between (1-10 sec).

6. Shall have an analog input filter adjustment to limit the effects of noise on the control signal.

7. Shall have the ability to automatically restart after an over current, over voltage, under voltage, or loss of input signal protective trip. The number of restart attempts and trials shall be programmable.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.
   5. Test plugs.
   6. Test-plug kits.

1.2 ACTION SUBMITTALS

A. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of this particular specification section.
   1. The manufacturer shall resubmit this specification section showing compliance with each respective paragraphs and specified items and features.
   2. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
   3. Individual or partial submittals are not acceptable and will be returned without review.

B. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ADJUSTABLE ANGLE THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trerice, H. O. Co.
   2. Weiss Instruments, Inc.
   3. WIKA Instrument Corporation – USA.

B. Standard: ASME B40.200
C. Case: V-shape design, cast aluminum.

D. Fill type: Blue liquid

E. Connector Type(s): Union joint, adjustable angle, lockable.

F. Connector Size: 3/4 inch, with ASME B1.1 screw threads.

G. Stem: 304 Stainless steel.

H. Window: Glass or ultraviolet protective acrylic.

I. Scale Size: 9 inches.

J. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: CUNI.
   4. Material for Use with Steel Piping: Type 316 stainless steel.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell’s internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ashcroft Inc
      b. Trerice, H. O. Co.
      c. Weiss Instruments, Inc.
      d. WIKA Instrument Corporation - USA.
   3. Case: Silicone liquid filled, hermetically sealed, solid-front, pressure relief type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
   4. Pressure-Element Assembly: Bourdon tube.
   5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   6. Movement: Mechanical, with link to pressure element and connection to pointer.
   7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 TEST PLUG

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Peterson Equipment Co., Inc.
   2. Sisco Manufacturing Company, Inc.
   3. Trerice, H.O. Co.
   4. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS ¼ or NPS ½, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 275 °F.

F. Core Inserts: Nordel (Ethylene-Propylene self sealing rubber).

2.5 TEST-PLUG KITS

A. Temperature Readout Manufacturer & Model:
   1. Fluke Model 116-HVAC with (in addition) 80PK-22 Type K Probe

B. Pressure Gauge:
   1. Ashcroft Series D1005PS General Purpose Digital Gauge, provide (2) pressure gages 0 to 100 PSIG and 0 to 200 PSIG, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Carrying Case: provide carrying case with foam cutouts to hold Gauges with P/T probes, and a case for the Fluke 80PK-22 Type K Probe.

2.6 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermometers in the following locations:
   1. Inlet and outlet of air handling chilled water and hot water coil.
   2. Entrance and exit of main building service.
B. Install pressure gages in the following locations:
   1. Inlet and outlet of air handling chilled water and hot water coil.
   2. Entrance and exit of main building service.
   3. Discharge of each pressure-reducing valve.

C. Install pressure/temperature plug in the following locations:
   1. Next to a location of a pressure gauge, temperature gauge, or EMS pressure/temperature sensor location. Can use one plug location for common Temperature / Pressure / EMS readings.

END OF SECTION
SECTION 23 05 23

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze ball valves.

B. Related Sections:
   1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate and globe valves closed to prevent rattling.
4. Set ball valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES
   A. Refer to HVAC valve schedule articles for applications of valves.
   B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
   C. Valve Sizes: Same as upstream piping unless otherwise indicated.

2.2 BRONZE BALL VALVES (SIZES ½” THROUGH 2”)
   A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Milwaukee Valve Company.
         b. NIBCO INC.
         c. Watts Regulator Co.
      2. Description:
         b. SWP Rating: 150 psig.
         c. CWP Rating: 600 psig.
         d. Body Design: Two piece.
         e. Body Material: Bronze.
         f. Ends: Threaded.
         g. Seats: PTFE or TFE.
         h. Stem: Stainless steel.
         i. Ball: Stainless steel, vented.
         j. Port: Full.
      3. Products: subject to compliance with requirements, provide products by one of the following:
         a. Crane Co.
         b. Milwaukee Valve Company.
         c. NIBCO INC.
      4. Description:
b. CWP Rating: 200 psig.
d. Style: Compact wafer
e. Seat: Bronze.
f. Spring: Stainless Steel.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
3. Throttling Service: Globe, Ball, or high-performance butterfly valves.
4. Pump-Discharge Check Valves

a. NPS 2-1/2 and Larger: Iron, center-guided, metal-seat check valves.

3.2 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two-piece, full port, bronze with stainless-steel trim.
3. Bronze Gate Valves: Class 125, RS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
3. High-Performance Butterfly Valves: Class 150, single flange.
4. Iron Gate Valves: Class 125, OS&Y
5. Iron, Center-Guided Check Valves: Class 125, compact-wafer and globe, metal resilient seat.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Valve tags.
   5. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. The manufacturer, contractor or supplier shall resubmit the specification section and shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular section. Next to each specification item, indicate the following:
   1. "No Exception Taken".
   2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

E. Valve numbering scheme. See paragraph 2.7.B.

F. Valve Schedules: For each piping system to include in maintenance manuals.

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers:
   1. Craftmark Identification Systems
2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass or anodized aluminum, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   4. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Three-layer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick and having predrilled holes for attachment hardware.
   2. Color Coding:
      b. Background Color: Red.
   3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   6. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Color Coding:
   1. Background Color: Yellow.
2. Letter Color: Black.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless-steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.

B. General Requirements for Manufactured Pipe Labels: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger pipe sizes may have maximum sheet size with separate fastener.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing. Either marker shall show accepted color-coded background, proper color of legend in relation to background color, accepted legend letter size, accepted marker length.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with ¼-inch letters for piping system abbreviation and ½ inch sequenced numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2 by 11 inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS
A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as “DANGER”, “CAUTION” or “DO NOT OPERATE.”
4. Color:
   a. Background Color: Yellow.
   b. Letter Color: Black.

PART 3 - EXECUTION

END OF SECTION
Section 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
   a. Constant-volume air systems.
   b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:
   a. Constant-flow hydronic systems.
   b. Variable-flow hydronic systems.
   c. Primary-secondary hydronic systems.

3. Testing, Adjusting, and Balancing Equipment:
   a. Motors.
   b. Condensing units.
   c. Boilers.
   d. Pumps

4. Testing, adjusting, and balancing existing systems and equipment.
5. Sound tests.
6. Vibration tests.
7. Duct leakage tests.
8. Control system verification.

1.2 DEFINITIONS

B. BAS: Building automation systems.
D. TAB: Testing, adjusting, and balancing.
E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
F. TDH: Total dynamic head.

1.3 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site ith the Engineer and Commissioning Agent after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
1. Minimum Agenda Items:
   b. The TAB plan.
   c. Needs for coordination and cooperation of trades and subcontractors.
   d. Proposed procedures for documentation and communication flow.

1.4 ACTION SUBMITTALS

A. LEED Submittals:
   1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
   2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.


D. System Readiness Checklists: Submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Engage an independent TAB Contractor certified by AABC or NEBB.
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.
B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
   b. Duct systems are complete with terminals installed.
   c. Volume, smoke, and fire dampers are open and functional.
   d. Clean filters are installed.
   e. Fans are operating, free of vibration, and rotating in correct direction.
   f. Variable-frequency controllers' startup is complete and safeties are verified.
   g. Automatic temperature-control systems are operational.
   h. Ceilings are installed.
   i. Windows and doors are installed.
   j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers’ startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE Standard 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.
H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
   b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
   c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
   d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located at least two-thirds of the distance down the duct from the fan discharge or as shown on the Drawings.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer’s recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
   a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
   b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
   c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
   d. Adjust controls so that terminal is calling for minimum airflow.
   e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
   f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.

c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.

b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.

d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.

b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.

9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.

b. Re-measure and confirm that total airflow is within design.

c. Re-measure final fan operating data, rpms, volts, amps, and static profile.

d. Mark final settings.

e. Test system in economizer mode. Verify proper operation and adjust if necessary.

f. Measure and record all operating data.

f. Verify tracking between supply and return fans.

g. Verify building pressurization control by measuring building pressure at various operating conditions.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

### 3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

**A.** Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

**B.** Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

**C.** For systems with no diversity:

1. Adjust pumps to deliver total design gpm.
   
   a. Measure total water flow.

   1) Position valves for full flow through coils.
   2) Measure flow by main flow meter, if installed.
   3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

   b. Measure pump TDH as follows:

   1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
   2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
   3) Convert pressure to head and correct for differences in gage heights.
   4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.


2. Adjust flow-measuring devices installed in mains and branches to design water flows.

   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.
3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil and adjust the bypass valve to maintain
design flow.
   e. Perform temperature tests after flows have been balanced.
4. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure and verify that it is within manufacturer’s specified range.
   b. Perform temperature tests after flows have been verified.
5. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
6. Prior to verifying final system conditions, determine the system differential-pressure set
point.
7. If the pump discharge valve was used to set total system flow with variable-frequency
controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-
frequency controller to control system differential-pressure set point. Record pump data
under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps’ operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.
10. Verify that memory stops have been set.
D. For systems with diversity:
   1. Determine diversity factor.
   2. Simulate system diversity by closing required number of control valves, as approved by the
design engineer.
   3. Adjust pumps to deliver total design gpm.
      a. Measure total water flow.
         1) Position valves for full flow through coils.
         2) Measure flow by main flow meter, if installed.
         3) If main flow meter is not installed, determine flow by pump TDH or exchanger
            pressure drop.
      b. Measure pump TDH as follows:
         1) Measure discharge pressure directly at the pump outlet flange or in discharge
            pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.


4. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure, and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.

9. Prior to verifying final system conditions, determine system differential-pressure set point.

10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

11. Mark final settings and verify that memory stops have been set.

12. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

13. Verify that memory stops have been set.
3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.
B. Balance the secondary circuits after the primary circuits are complete.
C. Adjust pumps to deliver total design gpm.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gage heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after it is adjusted.
   4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:
   1. Measure and balance coils by either coil pressure drop or temperature method.
   2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
H. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps’ operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.10 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.
B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
D. Check settings and operation of each safety valve. Record settings.
E. Verify the operation of each steam trap.

3.11 PROCEDURES FOR HEAT EXCHANGERS

A. Adjust water flow to within specified tolerances.
B. Measure inlet and outlet water temperatures.
C. Measure inlet steam pressure.
D. Check settings and operation of safety and relief valves. Record settings.

3.12 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.13 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.
B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.14 PROCEDURES FOR BOILERS

A. Hydronic Boilers:
   1. Measure and record entering- and leaving-water temperatures.
   2. Measure and record water flow.
   3. Record relief valve pressure setting.

3.15 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Airflow.
   3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.

3.16 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels in each room.

B. Instrumentation:
1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:
1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:
1. Report shall record the following:
   a. Location.
   b. System tested.
   c. dBA reading.
   d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.17 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 25.

B. Instrumentation:
1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:
1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:
1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.18 DUCT LEAKAGE TESTS
A. Witness the duct pressure testing performed by Installer.
B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
C. Report deficiencies observed.

3.19 CONTROLS VERIFICATION
A. In conjunction with system balancing, perform the following:
1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller setpoints are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.
3.20 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

   1. Measure and record the operating speed, airflow, and static pressure of each fan.
   2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   3. Check the refrigerant charge.
   4. Check the condition of filters.
   5. Check the condition of coils.
   6. Check the operation of the drain pan and condensate-drain trap.
   7. Check bearings and other lubricated parts for proper lubrication.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

   1. New filters are installed.
   2. Coils are clean and fins combed.
   3. Drain pans are clean.
   4. Fans are clean.
   5. Bearings and other parts are properly lubricated.
   6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

   1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
   2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
   3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
   4. Balance each air outlet.

3.21 TOLERANCES

A. Set HVAC system’s airflow rates and water flow rates within the following tolerances:

   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Heating-Water Flow Rate: Plus or minus 10 percent.
   4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.
3.22 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.23 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Center-to-center dimensions of sheave and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
F. Apparatus-Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
   m. Refrigerant suction pressure in psig.
   n. Refrigerant suction temperature in deg F.
   o. Inlet steam pressure in psig.

G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Fuel type in input data.
   g. Output capacity in Btu/h.
   h. Ignition type.
   i. Burner-control types.
   j. Motor horsepower and rpm.
2. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Entering-air temperature in deg F.
   c. Leaving-air temperature in deg F.
   d. Air temperature differential in deg F.
   e. Entering-air static pressure in inches wg.
   f. Leaving-air static pressure in inches wg.
   g. Air static-pressure differential in inches wg.
   h. Low-fire fuel input in Btu/h.
   i. High-fire fuel input in Btu/h.
   j. Manifold pressure in psig.
   k. High-temperature-limit setting in deg F.
   l. Operating set point in Btu/h.
   m. Motor voltage at each connection.
   n. Motor amperage for each phase.
   o. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.
I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft.
   g. Indicated airflow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual airflow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in sq. ft.

   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Air velocity in fpm.
      c. Preliminary airflow rate as needed in cfm.
      d. Preliminary velocity as needed in fpm.
      e. Final airflow rate in cfm.
      f. Final velocity in fpm.
      g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
   a. System and air-handling-unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   g. Water pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump rpm.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.
3.24 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.

B. Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:
   1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
   3. If the second verification also fails, Owner may contact AABC or NEBB Headquarters regarding the Performance Guaranty.

F. Prepare test and inspection reports.

3.25 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply, return and make-up air.
   2. Indoor, exposed supply and return air.
   3. Outdoor, exposed supply and make-up air.

B. Related Sections:
   1. Section 230719 "Pipe Insulation."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Owens Corning; SOFTR All-Service Duct Wrap.
2.2 DUCT LINING

A. Manufacturer:
   1. Schuller/Manville
   2. Owens-Corning
   3. Pittsburgh
   4. Certainteed

B. For the outdoor application use 2 in. lining and for the indoor application use 1-1/2 in. lining.
   1. Rectangular ductwork: Fiberglass Schuller/Manville Permacote Linacoustic flexible duct liner insulation with approved fire-resistant coating for erosion control, bonded with a dark thermosetting resin. The airstream surface and long edges shall be protected with acrylic coating. Apply to flat sheets with full coverage adhesive and insulation pins prior to fabrication of ducts or fittings. Lining shall be dual density duct liner. Duct sizes indicated on Drawings are net inside acoustical lining insulation dimensions, increase duct sizes accordingly.
   2. Circular ductwork: Fiberglass duct liner manufactured to fit small and large radius round ducts with approved fire-resistant coating for erosion control located as indicated on Drawings. Apply to round ducts with full coverage adhesive prior to fabrication of ducts or fittings. Lining shall be Schuller/Manville Spiracoustic Plus in ducts over 24 in. dia., Schuller/Manville Permacote Spiracoustic in ducts under 24 in. dia. Duct sizes shown are net inside duct liner. Increase duct sizes accordingly. Provide with duct liner adhesive design Polymericis (DP-2502)
   3. Line all ductwork as indicated on Drawings.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.
   2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers”.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor-Barrier Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 550.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (minus 46 to plus 104 deg C).
4. Solids Content: ASTM D1644, 33 percent by volume and 46 percent by weight.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: 20 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.6 FACTORY-APPLIED JACKETS
A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II. when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.
3. Finish and thickness are indicated in field-applied jacket schedules.
5. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper 2.5-mil-thick polysurlyn.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following:
a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. GEMCO; Peel & Press.
      c. Midwest Fasteners, Inc.; Self Stick.
   2. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   3. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   4. Adhesive-backed base with a peel-off protective cover.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. AGM Industries, Inc.; RC-150.
      b. GEMCO; R-150.
      c. Midwest Fasteners, Inc.; WA-150.
      d. Nelson Stud Welding; Speed Clips.
      e. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

D. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

E. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers: Subject to compliance with requirements, provide product by:
      a. C & F Wire, or equal.
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Heating Hot Water piping, indoors and outdoors.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied), if any.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2 GLASS FIBER

A. Manufacturers: Owens-Corning Fiberglass 25 ASJ/SSL, Johns Manville Micro-Lok, Certainteed, Knauf or equal.

B. Type I, 850 deg F Materials; Mineral or glass fibers bonded with thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied ASJ-SSL jacket. Factory applied jacket requirements are specified in “Factory Applied Jackets” Article.

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.4 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with closed seal.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers: Subject to compliance with requirements, provide product by:

2.5 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket Jacket: Aluminum jacket shall comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14; thickness as scheduled; roll stock ready for shop or field cutting and forming. Moisture Barrier for Outdoor Applications: 3-mil thick, heat bonded polyethylene and kraft barrier.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Preformed 2-piece or gore, 45- and 90- degree, short- and long-radius elbows.
   b. Tee covers.
   c. Flange and union covers.
   d. End caps.
   e. Beveled collars.
f. Valve covers.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping
2. Air-vent piping.

1.2 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping 125 psig at 200 deg F.
2. Air-Vent Piping: 200 deg F.
3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves. Include flow and pressure drop curves based on manufacturer’s testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air control devices.
4. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Field quality-control test reports.
1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air control devices, hydronic specialties, and specialty-duty valves to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.

b. S. P. Fittings; a division of Star Pipe Products.

C. Wrought-Copper Unions: ASME B16.22.

2.2 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. Central Plastics Company.
d. Jomar International Ltd.
e. Matco-Norca, Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Description:
   b. Pressure Rating: 125 psig minimum at 180 deg F, 150 psig, 250 psig.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturer: Subject to compliance with requirements. Provide products by one of the following:
      a. Capitol Manufacturing Company
      b. Central Plastics Company
      c. Matco-Norca, Inc.
      d. Watts Regulator Co.; a Division of Watts Water Technologies, Inc.
      e. Wilkins; a Zurn Company

   2. Description:
      a. Standard: ASSE 1079
      b. Factory-fabricated, bolted, companion-flange assembly
      c. Pressure Rating: 175 psig
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company
      d. Pipeline Seal and Insulator, Inc.

   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure rating: 150 psig
      c. Gasket: Neoprene or phenolic
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers

E. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elster Perfection
      b. Grinnell Mechanical Products
c. Matco-Norca, Inc.
d. Precision Plumbing Products, Inc.
e. Victaulic Company

2. Description:
a. Standard: IAPMO PS 66
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded
e. Lining; Inert and non-corrosive, propylene.

2.3 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gosset Domestic Pump; a division of ITT Industries.
4. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
4. Inlet Connection: NPS ½
5. Discharge Connection: NPS ¼
6. CWP Rating: 150 psig
7. Maximum Operating Temperature: 240 deg F

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

B. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

C. Stainless-Steel Bellow, Flexible Connectors:

2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

D. Spherical, Rubber, Flexible Connectors:

2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

E. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2-1/2" and smaller, shall be the following:

1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered brazed joints.

B. Hot-water heating piping, aboveground, NPS 3" and larger shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

D. Makeup-water piping installed above ground shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Condensate-Drain Piping: Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes:
   2. Close-coupled, end-suction centrifugal pumps.
   4. Separately coupled, base-mounted, end-suction centrifugal pumps.
   5. Separately coupled, base-mounted, double-suction centrifugal pumps.

1.2 DEFINITIONS
A. Buna-N: Nitrile rubber.
B. EPT: Ethylene propylene terpolymer.

1.3 ACTION SUBMITTALS
A. The manufacturer, contractor or supplier shall resubmit the specification section and shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular section. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
B. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump’s operating point on curves.
C. Shop Drawings: For each pump.
   1. Show pump layout and connections.
   2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
   3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:
   1. Armstrong Pumps, Inc.
   2. ITT Corporation; Bell & Gossett.
   3. Paco Pumps.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:
   1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
   2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
   3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
   4. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
   5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
      a. Enclosure: Totally enclosed, fan cooled.
      b. Enclosure Materials: Cast iron.
      c. Motor Bearings: Permanently lubricated up through 5 HP. Grease-lubricated ball bearings for larger motor sizes.
      d. Efficiency: Premium efficient.
      e. NEMA Design: A.
      f. Service Factor: 1.15.
      g. Shaft Grounding: On all variable speed driven motors.

E. Capacities and Characteristics:
   1. Refer to Contract Documents.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:
   1. Armstrong Pumps, Inc.
   2. ITT Corporation; Bell & Gossett.
3. Paco Pumps.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:
   1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
   2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
   3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
   4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
   5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing with integral pump support.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
      a. Enclosure: Totally enclosed, fan cooled.
      b. Enclosure Materials: Cast iron.
      c. Motor Bearings: Permanently lubricated up through 5 HP. Grease-lubricated ball bearings for larger motor sizes.
      d. Efficiency: Premium efficient.
      e. NEMA Design: A.
      f. Service Factor: 1.15.
      g. Shaft Grounding: On all variable speed driven motors.

E. Capacities and Characteristics:
   1. Refer to Contract Documents.

2.3 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:
   1. Armstrong Pumps, Inc.
   2. ITT Corporation; Bell & Gossett.
   3. Paco Pumps.

B. Description: Factory assembled and tested, centrifugal, overhung-impeller, separately coupled, fully epoxy painted, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.

C. Pump Construction:
   1. Pump: Radially split or split-coupled, single stage centrifugal type with rigid spacer type coupling.
2. Casing: Bronze fitted, with equal size suction and discharge flanges and having separate
tapped flush line and pressure gauge connections.
3. Impeller: Bronze and shall be dynamically balanced.
5. Coupling: Rigid spacer type constructed of high tensile aluminum alloy. Coupling shall be split to allow removal from pump and motor shafts, leaving space between the shafts sufficient to replace all mechanical seal components without disturbing the pump or motor.
6. Seal: Mechanical seal with outside balanced type and carbon rotating face, ceramic stationary seal and Viton secondary seal.
7. Condenser Water: Pump shall be fitted with a factory installed flush line.
   a. Provide in the flush line to the mechanical seal a 50-micron cartridge filter and sight flow indicator, to suit the working pressure encountered.
   b. For pumps with differential pressures exceeding 30 psig, provide the flush line to the mechanical seal cyclone type separator, with sight flow indicator.
8. Pump Stanchion: Stanchion bracket support with height based on field conditions.

D. Motor: Single speed and rigidly mounted to pump casing with lifting eyebolt and supporting lugs in motor enclosure.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
      a. Enclosure: Totally enclosed, fan cooled.
      b. Enclosure Materials: Cast iron.
      c. Motor Bearings: Permanently lubricated up through 5 HP. Grease-lubricated ball bearings for larger motor sizes.
      d. Efficiency: Premium efficient.
      e. NEMA Design: A.
      f. Service Factor: 1.15.
      g. Shaft Grounding: On all variable speed driven motors.

E. Capacities and Characteristics:
   1. Refer to Contract Documents.

2.4 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:
   1. Armstrong Pumps, Inc.
   2. ITT Corporation; Bell & Gossett.
   3. Paco Pumps.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.

C. Pump Construction:
   1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.

3. Pump Shaft: Steel, with copper-alloy shaft sleeve.

4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.

5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.


D. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, secured to mounting frame, with adjustable alignment.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment".

   a. Enclosure: Totally enclosed, fan cooled.
   b. Enclosure Materials: Cast iron.
   c. Motor Bearings: Permanently lubricated up through 5 HP. Grease-lubricated ball bearings for larger motor sizes.
   d. Efficiency: Premium efficient.
   e. NEMA Design: A.
   f. Service Factor: 1.15.
   g. Shaft Grounding: On all variable speed driven motors.

H. Capacities and Characteristics:

1. Refer to Contract Documents.

2.5 SEPARATELY COUPLED, BASE-MOUNTED, DOUBLE-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps, Inc.
2. ITT Corporation; Bell & Gossett.
3. Paco Pumps.

B. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.

C. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, Class 125 flanges. Casing supports shall allow removal and replacement of impeller without disconnecting piping.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.


4. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. EPDM coupling sleeve for variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, secured to mounting frame, with adjustable alignment.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

   a. Enclosure: Totally enclosed, fan cooled.
   b. Enclosure Materials: Cast iron.
   c. Motor Bearings: Permanently lubricated up through 5 HP. Grease-lubricated ball bearings for larger motor sizes.
   d. Efficiency: Premium efficient.
   e. NEMA Design: A.
   f. Service Factor: 1.15.
   g. Shaft Grounding: On all variable speed driven motors.

A. Capacities and Characteristics:

   1. Refer to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all pumps before installation. Reject pumps that are damaged.

B. Before pump installation, examine:

   1. Equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   2. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
3. Final pump locations indicated on Drawings are diagrammatic and approximate. Determine exact locations before roughing-in for piping and electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4 and HI 2.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check and shutoff valves on discharge side of pumps.

F. Install strainer or suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Open discharge valve slowly.

3.6 DEMONSTRATION
   A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA’s "Seismic Restraint Manual: Guidelines for Mechanical Systems."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Access panels.

B. Welding certificates.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:


B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Exhaust system shall comply with CMC Section 505 and 506. Hot gas exhaust ductwork shall conform to CMC Section 816, 817 and 818. Both systems shall comply also to NFPA 91.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS
A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 SINGLE-WALL ROUND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards"
- Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

**B. Galvanized Sheet Steel:** Comply with ASTM A 653/A 653M.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

**C. Reinforcement Shapes and Plates:** ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

**D. Tie Rods:** Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 **DUCT LINER**

**A. Fibrous-Glass Duct Liner:** Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.
   e. Or approved equal.
   f. Maximum Thermal Conductivity:
      1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. **Water-Based Liner Adhesive:** Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

   a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

**B. Flexible Elastomeric Duct Liner:** Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA Inc.
b. Armacell LLC.
c. Rubatex International, LLC
d. Or approved equal.

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
   a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
   6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
   7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
   8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
      a. Fan discharges.
      b. Intervals of lined duct preceding unlined duct.
      c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
   9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
      a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.
   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Hilti Corp.
   2. TOLCO; a brand of NIBCO INC.
   3. Unistrut Corporation; Tyco International, Ltd.
   4. Or approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies ductwork accessories such as volume control dampers, back-draft dampers, air turning vanes, flexible duct connections, duct access doors, duct test holes, combination fire smoke dampers and intake vents.

1.2 QUALITY ASSURANCE

A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

   - NFPA 90A  Installation of Air Conditioning and Ventilating Systems.
   - SMACNA  Low Pressure Duct Construction Standards.
   - UL 33  Heat Responsive Links for Fire-Protection Service.
   - UL 555  Fire Dampers and Ceiling Dampers.

1.3 ACTION SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 230000.

B. Product Data: For each type of product.

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

      a. Special fittings.
      c. Combination fire- and smoke-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
      d. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Fusible Links: Furnish quantity equal to 10 percent of amount installed

PART 2 - PRODUCTS

2.1 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.

D. Fabricate single blade dampers for duct sizes to 12 x 48 inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.2 BACKDRAFT DAMPERS

A. Manufactures shall be Ruskin, Greenheck or equal.

B. Gravity back-draft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer’s standard construction.

C. Fabricate multi-blade, parallel action gravity balanced back-draft dampers of extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 AIR TURNING VANES

A. Multi-blade device with blades aligned in short dimension; blades shall have long trailing edges; steel or aluminum construction; with individually adjustable blades, mounting straps. Manufacturer shall be Aero/Dyne or equal (no known equal).
2.4 FLEXIBLE DUCT CONNECTIONS

A. Manufacturer: Ventfrabrics or equal (no known equal).

B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

C. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.

D. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.5 DUCT ACCESS DOORS

A. Manufacturers shall be Ventfrabrics, Ductmate, Pottorf Company or equal.

B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.

C. Review locations prior to fabrication.

D. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

E. Access doors smaller than 12 inches square may be secured with sash locks.

F. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

G. Access doors in round ducts shall be Ductmate, United Sheet Metal Type AR-W Peabody, Wind Spiromatic, Spiro-Duct or equal.

H. Access doors with sheet metal screw fasteners are not acceptable.

2.6 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.7 COMBINATION FIRE/SMOKE DAMPERS

A. Manufacturer shall be Greenheck, Ruskin, Pottoff, or equal.

B. Combination Smoke/Fire Dampers shall be furnished and installed at all locations shown on the plans and/or as described on the drawing details.

C. Damper shall meet the requirements of NFPA 90A, 92A, and 92B and further shall be tested, rated and labeled in accordance with the latest edition on UL Standard 555 and 555S. Dampers shall have a UL555 fire rating of 1-1/2 hours and be of low leakage design qualified to UL 555S Leakage Class I.
D. Damper actuator combination shall have a UL 555S elevated temperature rating of 350 degrees Fahrenheit minimum and shall be operational and dynamic rated to operate at maximum design airflow rate at its installed location.

E. Damper shall be supplied with an appropriate actuator installed by the damper manufacturer at the time of damper fabrication. Damper actuator shall be electric type for 120 volt operation.

F. Damper blades shall be 16 gauge galvanized steel 3 Vee type with three longitudinal grooves for reinforcement. Damper frame shall be galvanized steel formed into a structural hat channel shape with reinforced corners. Bearing shall be sintered bronze sleeve type rotating in extruded holes in the damper frame. Blade seals shall be silicone rubber designed to inflate and provide a tighter seal against leakage as pressure on either side of the damper increases. Jamb seals shall be stainless steel compression type with silicone rubber backing. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper.

G. Damper must be rated for mounting vertically (with blades running horizontally) or horizontally and be UL 555S rated for leakage and airflow in either direction through the damper.

H. Damper shall be supplied with a 165 degree Fahrenheit fusible link. Provide access doors at either side of the combination smoke/fire damper for viewing of the fusible links.

I. The specified combination smoke/fire damper shall meet the requirements for fire dampers, smoke dampers and combination fire smoke dampers established by:
   2. Underwriters Laboratories Standard 555 Listing #R-13317
   3. Underwriters Laboratories Standard 555S Listing #R-13447
   4. California State Fire Marshall CSFM Fire Damper Listing #3225-0981:103
   5. California State Fire Marshall CSFM Leakage Smoke Damper Listing #3230-0981:104

J. Smoke Detector will be provided by the electrical contractor to be compatible with the fire alarm system. Mechanical contractor shall install all duct-mounted smoke detectors. Electrical contractor shall connect smoke detector to smoke dampers and fire alarm panel. After installation is complete, electrical contractor shall test and verify that smoke detectors are active and functional.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Centrifugal Roof Ventilators

1.2 PERFORMANCE REQUIREMENTS
   A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
   B. Operating Limits: Classify according to AMCA 99.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
      1. Certified fan performance curves with system operating conditions indicated.
      2. Certified fan sound-power ratings.
      3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
      4. Material thickness and finishes, including color charts.
      5. Dampers, including housings, linkages, and operators.

1.4 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Belts: One set for each belt-driven unit.

1.6 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
   C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.7 COORDINATION
A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck
2. Loren Cook
3. Twin City Fans

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:
   1. Resiliently mounted to housing.
   2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   5. Fan and motor isolated from exhaust airstream.

E. Accessories:
   1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
   2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Overall Height: 8 inches.
   3. Sound Curb: Curb with sound-absorbing insulation.
   5. Metal Liner: Galvanized steel.

G. Provide with VariGreen ECM

2.2 SOURCE QUALITY CONTROL
A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. The large diameter ceiling fan is the model scheduled with the performance capabilities expressed. Included with the ceiling fan will be the select mounting hardware relevant to the model and application space. The ceiling fan shall be furnished with manufacturer's associated wall controller and temperature sensor. The HVLS fan will provide thorough, energy efficient air movement to achieve thermal comfort.

1.2 RELATED SECTIONS

A. 23 00 00 – Heating, Ventilating, and Air Conditioning (HVAC)
B. 23 34 00 – HVAC Fans

1.3 REFERENCES

A. Underwriters Laboratories (UL 507)
B. CE
C. IP
D. National Fire Protection Agency (NFPA 13)

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data: Manufacturer’s data sheets on each product to be used shall include:
   
   1. Storage and handling requirements and recommendations
   2. Power and mounting requirements
   3. Application Drawings: Submit plan, section, elevation and isometric views as necessary to convey the information required to detail all installation conditions for each unit specified.

C. Installation Manual: The manufacturer will provide an installation, operation, and maintenance document for the fan. Information included in the document may change without notice.

1.5 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimal results. Do not install products in environmental conditions outside of fan absolute limits. The storage of all fan products prior to installation will be in an "out of weather" position. Failure to maintain the integrity of the shipment is not the responsibility of the fan manufacturer.
1.6 WARRANTY

A. Manufacturer’s standard warranty:

1. Lifetime warranty on airfoils and mounting
2. 50,000-hour warranty on all other components, which include but are not limited to:
   a. Motor
   b. Integrated Drive
   c. Controller/Remote

B. At project closeout, provide to Owner or Owner’s Representative an executed copy of manufacturer’s standard limited warranty against manufacturing defect, outlining its terms, conditions and exclusions from coverage.

1.7 COORDINATION

A. The fan shall be capable of receiving a stop command from the fire panel, an ASD (Aspirating Smoke Detection) device, or any number of smoke, flame or heat detectors.

B. The fans shall be as follows:

1. The fan shall meet the air velocity requirements of FM Global’s 2.0 data sheet for ESFR sprinklers.
2. If required by the local fire prevention authority or desired by the purchaser, the fan shall be wired into the building’s fire suppression system so that the fan will automatically shut off within a maximum of 90 seconds after sprinklers are activated. To facilitate this automatic shut-down, the low voltage wire and relay needed to accomplish this must be supplied by the Fire Alarm installer. See Manufactures installation instructions for further details.
3. Upon fire detection as described above, the fans shall coast to stop as required by NFPA guidelines.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: MacroAir Technologies, Inc. has been selected as the basis of design. Any alternates must meet the performance and match the aesthetics of the specified product.

B. Subject to compliance with specified requirements, manufacturers producing comparable products may include, but are not limited to, the following:

1. Delta T LLC dba Big Ass Fans
2. Or approved equal.

2.2 HIGH VOLUME, LOW SPEED FANS

A. Regulatory Requirements: Assembly standards
1. Sustainable Characteristics: The HVLS fan shall generate large volumes of thorough air movement throughout a space at a low velocity to create a comfortable environment at a low energy consumption, contributing to cost-efficient facility management and operation practices. The efficiencies of the high volume, low speed fan concept is such that air is thoroughly mixed within a space, achieving thermal equalization, and gentle air movement is delivered to occupants contributing to indoor air quality. The fan shall be capable of forward (counter-clockwise) and reverse (clockwise) performance capabilities, for cooling and heating solutions.

2. Direct Drive Motor: The fan shall utilize a Direct-Drive (D-Drive) transverse flux DC motor, utilizing a small ring of ultra-low resistance copper for a motor coil.

B. Performance

The fan shall be listed to applicable UL Standards and requirements by UL.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Horsepower</th>
<th>Hanging Weight</th>
<th>RPM</th>
<th>Power Usage</th>
<th>Industry Spacing***</th>
<th>Max Affected Area****</th>
<th>Max dBA*****</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 ft [2.44 m]</td>
<td>0.25 HP</td>
<td>65 lb [29.5 kg]</td>
<td>1-140 RPM</td>
<td>270 W</td>
<td>36 ft [11 m]</td>
<td>2,200 ft² [204 m²]</td>
<td>48</td>
</tr>
</tbody>
</table>

*** Delivers 2.8-4.2 ft/s of average air speed in the occupied space. This relates to perceived cooling or set point change or 4.9-6.1 F.

**** Delivers 2.7-3.8 ft/s of average air speed in the occupied space. This relates to a perceived cooling or set point change or 4.8-5.8 F.

*****Sound testing taken with the sensor 5 feet above the ground and 20 feet from the center of the fan with the fan running full speed and mounted at 20 feet high. dBA levels of the fan may alter dependent upon the application space and conditions.

C. Airfoils

The fan shall be equipped with six (6) aerospace aluminum, washdown XS airfoils. The airfoils shall consist of anodized 6061 T4 precision extruded aluminum and be of the MacroAir XS type design, with a fan diameter of 8 feet.

1. Number of Airfoils: 6
2. Airfoil Material: 6061 T4 Extruded Aluminum
3. Airfoil Finish: Anodized or powder coated per manufacturer’s standard color chart.

D. Motor

The fan shall be equipped with a Transverse Flux brushless DC motor designed for low speed high torque applications. The motor shall be driven sensor-less to eliminate the possibility of sensor or encoder failure.

1. Motor Type: Transverse Flux brushless DC Motor
2. Continuous Torque: 9.5 lbf (13 Nm)
3. Pole Count: 96
4. IP Rating: 65
5. Insulation Class: K (200 C)
7. Motor Housing: AISI 383 (ADC12)
8. Studs: AISI 4137 Grade 9 (JIS SCM435)

E. Integrated Drive

1. Electrical Requirements (Low Voltage)
   a. 104-253 VAC single (1) phase 50/60 Hz
2. Environment
   a. Operation: -10°C to 50°C
   b. Humidity: 0-95% non-condensing
   c. Cooling: Centrifugal cooling through blades

3. Operating Frequency: 20-50 KHz
4. Dynamic acceleration and deceleration
5. Modbus RS485 (19.2 8-N-1)

F. Controller: Basis-of-Design is MacroAir Controller 4 with 1 temperature sensor (model # 30-04007-00).
   1. Wall mount LCD touchscreen display panel.
      a. Run time, scheduling, temperature/humidity settings.
      b. Password protection
   2. Associated temperature sensor.

G. Mounting
   The fan mounting system shall be equipped with hardware, no less than SAE grade 5 for safe installation. The fan shall be equipped with a stress reliving swivel (SRS) mount.
   1. Glulam Hardware Kit
   2. Mounting Drop: 5 foot drop
   3. Mounting and Extension Material: Steel, Aluminum
   4. Mount Finish: Clear Anodized GAGE ATTACHMENTS

PART 3 - EXECUTION

3.1 PREPARATION
   A. Fan installation location requires a structural beam from which to mount the fan.
   B. Obstacles such as lights, racking, cables, or other structural components shall remain outside of the fan proximity. Consult the fan installation manual for proper placement.
   C. Check accuracy of dimensions indicated for openings to receive fans.
   D. Check location and availability of utility services to ensure proper voltage and installation preparation.
   E. Coordinate location and installation of the HVLS Fans, controller and temperature sensor.
   F. Ensure building structural members are sufficient to support the weight and operation of the fan.
   G. The fan requires a fused disconnect to be installed on the incoming power for emergency and maintenance use per national and international code compliance which may include CE, CSA, IEC, UL, and NEC.

3.2 INSTALLATION
   A. Install units per the fan installation manual.
B. Fan airfoil height to be a minimum of 10 feet from the floor.

C. Adjust unit as required for proper operation in accordance with manufacturer’s installation instructions.

D. Securely anchor units.

E. Ensure that operating parts turn freely prior to initial startup.

F. Repair or replace damaged parts, dents, buckles, abrasions or other damage affecting appearance or serviceability, as acceptable to Architect.

3.3 PROTECTION

A. Protect finished Work until date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.4 CLEANING

A. Clean Work per Section 01 77 00.

B. Clean and inspect fans per manufacturer’s instructions.

C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION
Section 23 36 00

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies pressure independent variable air volume boxes, hot water reheat coils and factory furnished bottom access door and controlled by Building Management System (BMS) direct digital control system.

1.2 QUALITY ASSURANCE

A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

NFPA 90A Installation of Air Conditioning and Ventilation Systems.
UL 181 Factory-Made Air Ducts and Connectors.

1. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
2. Air terminals shall be certified under ARI Standard 880-94 Certification Program and carry the ARI Seal.

1.3 SUBMITTALS

A. Submit the following under provisions of Section 230000.

B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.

1. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and NC designation, computer generated hot water reheat coil selections meeting design conditions indicated on plans.
2. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch wg.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Size and location of initial access modules for acoustic tile.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.
1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

1. Submit operation and maintenance data under provisions of Section 230000.
2. Include the following:
   a. Instructions for resetting minimum and maximum air volumes.
   b. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.1 AIR TERMINAL UNITS

A. Manufacturers shall be Carrier or approved equal

B. Ceiling mounted variable air volume (VAV) supply air control terminals for connection to low pressure duct, central air systems, with variable volume controls and hot water heating coils as indicated on Drawings. Identify each airflow unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory set air flow, minimum factory set air flow, and coil type. Coordinate with direct digital control system manufacturer for installation of VAV box controls.

2.2 VOLUME DAMPER

A. Locate air volume damper and cross-flow airflow measuring device inside unit casing. Construct from extruded aluminum or 20 gage galvanized steel components. Damper shaft shall rotate in a self-lubricating bearing. Nylon bearings are not acceptable.

B. Damper shall incorporate a mechanical stop to prevent over-stroking.

C. Mount manually operated damper quadrant or automatic damper operator, and automatic flow control assembly externally or provide access doors.

D. Externally mounted electric actuator shall position damper normally open as indicated.

2.3 HEATING COILS

A. Hot Water Heating Coil: 1/2 inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 300 psi with minimum burst pressure of 2000 psi at ambient temperature, factory installed.

B. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to the tubes.

C. Tubes shall be copper with aluminum wall thickness of 0.016” with male solder header connections.

D. Coil shall be enclosed in a minimum 20 gauge steel casing with slip and drive construction for attachment to metal ductwork. Coils shall be factory installed on the terminal discharge.

E. Capacity, number of rows and circuits: As scheduled on Drawings.

2.4 WIRING
A. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source. Provide toggle disconnect switch and 120 volt to 24 volt transformer in each air terminal control box. Refer to Division 26 for additional requirements.

2.5 CONTROLS

A. Automatic Damper Operator: Electric Actuator: 24 volt with high limit.

B. Coordinate with direct digital control system manufacturer for installation of controls.

2.6 TESTS

A. Provide testing of units under provisions.

B. Test run volume dampers and controls. Check sequence of operation and air flow limits at factory prior to shipment.

C. Base performance on tests conducted in accordance with ADC 1062.

D. Maximum Casing Leakage: 10-cfm at 1.5 inch inlet static pressure.

E. Maximum Damper Leakage: 5-cfm at 1.5 inch inlet static pressure.

END OF SECTION
PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ceilings diffusers shall be hinged removable perforated plate 24 X 24 lay in tee bar type and surface mounted with integral opposed blade volume control and removable and rearrangeable cores (cores shall be removable & rearrangeable without removing diffuser from ceiling) multi-deflection spring clip core. Tee bar type diffusers shall be Krueger 1240PE (Frame 23) and surface mounted type diffusers shall be Krueger 1240p (Frame 22) or approved equal. Finish to be baked white enamel.

B. Ceilings return, exhaust, transfer and relief registers & grilles shall be perforated plate tee bar type and surface mounted. Tee bar type registers and grilles shall be Krueger 6490 (Frame 23) and surface mounted type shall be Krueger S80P (Frame 22) or approved equal. Finish shall be baked white enamel. Registers shall have integral opposed blade volume control.

C. Supply registers shall be bar type double deflection Krueger 880H or approved equal with integral opposed blade damper. Finish to be baked white enamel.

D. Wall or exposed duct return, exhaust transfer and relief registers and grilles shall be Krueger S80H or approved equal. Finish to be baked white enamel. Registers shall have integral opposed blade volume control.

E. Filter ceiling return, exhaust, transfer and relief registers & grilles shall be perforated plate tee bar type and surface mounted. Tee bar type registers and grilles shall be Krueger S80P-4FF frame 23 and surface mounted type shall be Krueger S80P-4FF frame 22 or approved equal. Finish shall be baked white enamel. Registers shall have integral opposed blade volume control.

F. Filter wall or exposed duct return, exhaust transfer and relief registers and grilles shall be Krueger S80P-4FF frame 22 or approved equal. Finish to be baked white enamel. Registers shall have integral opposed blade volume control.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gas-fired, water-tube condensing boilers, trim, and accessories for generating hot water.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For boiler, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control reports.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

E. Manufacturer Start-up report

F. Other Informational Submittals:
   1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Water-Tube Condensing Boilers: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.

E. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

F. Mounting Base: For securing boiler to concrete base.

2.2 WATER-TUBE CONDENSING BOILERS

A. Manufacturers:
   1. Raypak
   2. Parker Boiler
   3. RBI

B. Description: Factory-fabricated, -assembled, and -tested, copper-finned, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.


D. Combustion Chamber: Stainless steel, sealed.

E. Burner: Natural gas, forced draft drawing from gas premixing valve.

F. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   
   a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

H. Ignition: Silicone carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.

I. Integral Circulator: Cast-iron body and stainless-steel impeller sized for minimum flow required in heat exchanger.

J. Casing:
   
   1. Jacket: Sheet metal, with snap-in or interlocking closures.
   2. Control Compartment Enclosures: NEMA 250, Type 1A.
   4. Insulation: Minimum 2-inch thick, mineral-fiber insulation surrounding the heat exchanger.

K. Capacities and Characteristics: See schedule on plans.

2.3 TRIM

A. Include devices sized to comply with ASME B31.9.

B. Safety Relief Valve: ASME rated.

C. Pressure and Temperature Gage: Minimum 3-1/2-inch diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

D. Boiler Air Vent: Automatic.


F. Circulation Pump: Nonoverloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.4 CONTROLS

A. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

   1. Hardwired Points or communications interface:

   b. Control: On/off operation, hot-water-supply temperature set-point adjustment.
2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

END OF SECTION
PACKAGED ROOF TOP AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged, large-capacity, rooftop air conditioning units (RTUs) with the following components and accessories:

1. Casings.
2. Fans.
3. Motors.
5. Refrigerant circuit components.
6. Air filtration.
7. Gas furnaces.
8. Dampers.
9. Electrical power connections.
10. Controls.
11. Accessories
12. Roof curbs.

1.2 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electronically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, large-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

E. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

F. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.3 ACTION SUBMITTALS

A. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware, or accessory complies with the requirement of this particular specification section.

1. The manufacturer shall resubmit this specification section showing compliance with each respective paragraphs and specified items and features.
2. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
3. Individual or partial submittals are not acceptable and will be returned without review.

B. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

1. Factory selection calculations for each antimicrobial ultraviolet lamp installation.

C. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.

D. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Seismic Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
3. Roof curbs and flashing.
4. Roof curb mounting details.

B. Seismic Qualification Data: Certificates, for RTUs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Restraint of internal components, including fans, coils, and refrigeration components.

C. Field quality-control reports.

D. Startup service report.

E. Sample Warranty: For special warranty.
1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan, where applicable.
2. Filters: One set of filters for each unit.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than ten years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer’s standard, but not less than three years from date of Substantial Completion.
5. Warranty Period for Antimicrobial Ultraviolet Lamp System: Lifetime with exception of lamps.
6. Warranty Period for Economizer Dampers and Assembly: Not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. AHRI Compliance:

1. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 270 for testing and rating sound performance for RTUs.
3. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
4. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested in accordance with AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

C. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - “Systems and Equipment” and Section 7 - “Construction and Startup.”
D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. NFPA Compliance: Comply with NFPA 90A or NFPA 90B.

F. UL Compliance: Comply with UL 1995. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:

   1. Trane
   2. Carrier
   3. York

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design mounting and restraints for RTUs, including comprehensive engineering analysis.

   1. Design RTU supports to comply with seismic performance requirements.

B. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to ASCE 7.

   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified"

2.4 CASINGS

A. Cabinet: Galvanized steel, phosphatized, and finished with paint coating certified at 1000 hours in salt spray test in compliance with ASTM B117.

B. Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.

C. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.

D. Units base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.

E. Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.

F. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.

G. The base of the units shall have rigging/lifting holes for crane maneuvering.
H. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.5 FANS

A. Supply-Air Fans: Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
   1. Direct-Driven Supply-Air Fans: Motor shall be resiliently mounted in the fan inlet.
   2. Belt-Driven Supply-Air Fans: Motors shall be installed on an adjustable fan base resiliently mounted in the casing.

B. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated multispeed motors.

C. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

2.6 MOTORS

A. Comply with Section 230513 "Common Motor Requirements for HVAC Equipment" and the requirements of this Article.

B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.7 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating, formed with pitch and drain connections complying with ASHRAE 62.

B. Supply-Air Hydronic Heating Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor and with air vent and drain.

C. Hot-Gas Reheat Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Suction-discharge bypass valve.

2.8 AIR FILTRATION

A. General: Each filter section shall be designed and constructed to house specific type of filter indicated on equipment schedule. Provide filters of type indicated on schedule. A hinged access door shall be provided on side of section. Internal blank-offs shall be provided to prevent air bypass around filters.
1. Filters shall be standard, commercially available sizes.
2. Only one size filter per unit is allowed.

B. Filter tracks in flat or cartridge filter sections: Filter tracks in flat or cartridge filter sections shall be upstream loaded Type 8 constructed from galvanized steel to ensure rigidity and tight tolerances. Tracks must be field adjustable without tools and designed to accept standard-size filters with one inch, 2-inch, or 4-inch widths.

C. Filter tracks in angle filter sections: Filter tracks in angle filter sections shall be constructed from galvanized steel to ensure rigidity and tight tolerances. Angle filter sections shall be designed to hold 2-inch filters of standard sizes, arranged in horizontal V-formation.

D. Bag or cartridge filter sections: Bag or cartridge filter sections shall be capable of accepting standard size 12-inch deep rigid media or bag filters. When bag/cartridge filters are installed in a positive pressure application, section shall be furnished with upstream service filter access and doors shall open inward against pressure for safety and leak integrity. For filters with lengths longer than 12 inches, additional plenum sections shall be furnished. Filter sizes shall be 24 by 24-inch or 12 by 24-inch only.

2.9 GAS FURNACES

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.
   1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.
   1. Fuel: Natural gas.
   2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger and Drain Pan: Stainless steel.

2.10 ANTIMICROBIAL ULTRAVIOLET LAMP SYSTEM

A. Description: Lighting unit installation in rooftop unit with lamps, reflectors, remote water-resistant power supply and cable, and support brackets. Lamps emit 254 nm UV "C" (UVC) band. In metal housing with viewport arranged for and controlled to cycle on and off with cooling coil. Locate downstream of cooling coils and over condensate drain pans.

2.11 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel blade galvanized-steel dampers mechanically fastened to cadmium plated or galvanized-steel operating rod in reinforced cabinet.
   1. Leakage Rate: Damper leakage shall not exceed 7 CFM/ft2 at 1.0” of static pressure when tested in accordance with AMCA standard 500.
   2. Damper Reliability Testing: Comply with current version California Title 24, Part 6
   3. Damper Motor: Modulating with adjustable minimum position.

B. Relief-Air Damper: Gravity actuated or motorized.

2.12 ELECTRICAL POWER CONNECTIONS
A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.13 CONTROLS

A. Control of equipment and sequence of operation are specified in Section 230923 “Direct Digital Control (DDC) System for HVAC” and Section 230993 “Sequence of Operation for HVAC Controls.

B. Thermostat

1. Wall-mounted thermostat or sensor with the following features:
   b. Fan on-auto switch.
   c. Fan-speed switch.
   d. Automatic changeover.
   e. Adjustable deadband.
   f. Exposed set point.
   g. Exposed indication.
   h. Degree F indication.
   i. Unoccupied-period-override push button with maximum 4-hour override.
   j. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.
   k. Occupied and unoccupied periods on seven day clock with a minimum of four programmable periods within 24 hours.

C. Integral controller

1. Unit shall be complete with low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
2. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit should any of the following standard safety devices trip and shut off compressor:
   a. Loss-of-charge/Low-pressure switch.
   b. High-pressure switch.
   c. Freeze-protection thermostat, evaporator coil. If any of the above safety devices trip, an LED (light-emitting diode) indicator shall flash a diagnostic code that indicates which safety switch has tripped.
3. Unit shall incorporate “AUTO RESET” compressor over temperature, over current protection.
4. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.
5. Unit control board shall have on-board diagnostics and fault code display.
6. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to 0 °F.
7. Control board shall monitor each refrigerant safety switch independently.
8. Control board shall retain last 5 fault codes in non-volatile memory, which will not be lost in the event of a power loss.

D. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACNET compatible interface for central HVAC control workstation for setpoint adjustment and system monitoring.

E. Fault Detection: Provide Fault Detection and Diagnostics (FDD) system in accordance with Title 24.

2.14 ACCESSORIES

A. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

B. Remote potentiometer to adjust minimum economizer damper position.

C. Return-air bypass damper.

D. Factory- or field-installed demand-controlled ventilation.

E. Safeties:
   1. Smoke detector.
   2. Condensate overflow switch.
   3. Phase-loss protection.
   4. High pressure control.
   5. Gas furnace airflow-proving switch.

F. Coil guards of painted, galvanized-steel wire.

G. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

H. Vertical vent extensions to increase the separation between the outdoor-air intake and the flue-gas outlet.

I. Door switches to disable heating or reset set point when open.

J. Outdoor air intake weather hood.

2.15 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 1 inch
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.

d. Liner Adhesive: Comply with ASTM C 916, Type I.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set(s) for each fan coil unit.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:
1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:
   a. For Compressor: Five year(s) from date of Substantial Completion.
   b. For Parts: Five year(s) from date of Substantial Completion.
   c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
   1. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
   2. Fujitsu
   3. LG

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Wall-Mounted or Ceiling mounted, Evaporator-Fan Components:

   1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
   2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
   3. Fan: Direct drive, centrifugal.
   4. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
      b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
c. Enclosure Type: Motors shall be open drip proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.

d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

e. Mount unit-mounted disconnect switches on exterior or interior of unit.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

6. Condensate Drain Pans:

a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.


c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

   1) Minimum Connection Size: 3/4 inch.

7. Air Filtration Section:

a. General Requirements for Air Filtration Section:

   1) Comply with NFPA 90A.

   2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

   3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

   1) Factory-fabricated, viscous-coated, flat-panel type.

   2) Thickness: 1 inch.

   3) Arrestance according to ASHRAE 52.1: 80.

   4) Merv according to ASHRAE 52.2: 5 to ASHRAE 52.2.8

   5) Media: Interlaced glass fibers sprayed with nonflammable adhesive.

   6) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish on inside and outside. Access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

2. Compressor: Fully hermetic with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current.

a. Compressor Type: Scroll.

b. Refrigerant Charge: R-410A.

c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Fan: Direct drive propeller type, horizontal discharge, blow through configuration.
Blades shall be statically and dynamically balanced with a PVC coated metal protective grille.


5. Low Ambient Kit: Permits operation down to 25 deg F (7 deg C).


7. Outdoor coil: Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

2.4 ACCESSORIES

A. Thermostat: Wired thermostat to control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

D. Drain Hose: For condensate.

E. Additional Monitoring:

1. Monitor constant and variable motor loads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports detailed on the construction plans. Anchor units to supports per plans.

D. Install seismic restraints.

E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch (25 mm). See Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS
A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION
SECTION 25 00 00
INTEGRATED AUTOMATION SYSTEMS (IAS) FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. Related Specifications:
   
   D. Section 250600 - Network Scheduling Software for HVAC
   
   E. Section 250800 – Fault Detection and Diagnostics Software for HVAC
   
   F. Section 251400 – IAS Network Controllers for HVAC
   
   G. Section 251500 – IAS Software and Programming Tools for HVAC

1.02 SUMMARY

A. This section describes the Systems Integration scope of work for the project.

B. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

C. It is the owner’s goal to implement an Open Protocol that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

D. This section Includes:

   E. Project Specific Scope of Work
   
   F. General IAS Installation Scope of Work
   
   G. Codes, Reference Standards, Definitions and Abbreviations
   
   H. Quality Assurance

1.03 SCOPE OF WORK

A. This project requires the installation of a new Integrated Automation System (IAS) campus building network constructed on the campus’ existing Tridium Niagara 4 Framework platform. The IAS system provided shall utilize BACnet certified field level control devices and Niagara JACE network controllers networked to the existing campus Niagara 4 Supervisor.

B. Coordinate and work with other intelligent building controls systems to provide all required JACE’s, web servers, and control components to allow for seamless control and communication at the graphic interface console. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the District.
C. Provide Graphical User Interface Development for all of the devices identified above and illustrated within the IAS drawings. Refer to Section 25 15 00 and the Graphics Requirements Guideline A.

D. It is the contractor’s responsibility to review all of the design documents and specifications and report any discrepancies to the District.

1.04 GENERAL IAS INSTALLATION SCOPE OF WORK

A. The IAS components shall utilize Tridium JACE 8000 network controllers, enterprise connectivity, electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified. The IAS will consist of monitoring and control of systems identified within the IAS drawings, which include integration of HVAC.

B. The procurement and installation of Niagara 4 JACE Network Controllers and BACnet DDC control system devices for the project HVAC equipment. This includes all hardware, electrical installation, configuration, programming and commissioning coordination for the DDC system.

C. Contractor shall integrate into the District Niagara 4 based open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The District shall be the named license holder of all software associated with any and all incremental work on the project.

D. The District shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, IAS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the District.

E. The Niagara Compatibility Statement (NICS) for all Niagara Software shall allow open access and be set as follows: Accept Station In = *; Accept Station Out = *; Accept Tool In = *; Accept Tool Out = *. In any case, the District shall maintain the right to direct Tridium to modify any software license, regardless of supplier, as desired by the District.

F. Intelligent Equipment Integration. Network installation, software integration, network communication, and equipment configuration for all equipment types specified to be integrated shall be provided with a factory installed or equipment manufacturer provided communication card. Refer to IAS drawings. Coordination with other trades to ensure that all equipment to be integrated is ordered with the proper communication cards and/or equipment required for proper integration.

H. All hardware installed for the project shall be constructed in a modular fashion to permit the next generation and support components to be installed in replace of or in parallel with existing components.

I. Provision of all documentation called out in these specifications including, but not limited to, submittals, O&M manuals, commissioning submittals, CAD based as-built documentation, and training manuals. Provide both hard copies and electronic files on electronic media.

J. Training of facility personnel, and or maintenance contractor, on the operation and maintenance of the system as called out in these specifications.

K. Hardware, Software and Labor as detailed and described on the IAS drawings and the Division 25 specifications.
L. The repair of all finished surfaces effected as a result of IAS related installation work. This includes but is not limited to carpet, drywall, paint ceiling tiles, furniture, etc.

M. DDC Controller programming and commissioning.

N. System point to point check out, verification and documentation.

O. Graphical User Interface Development. The Contractor shall develop the graphics, tools, features, and network integration required and as defined in section 25 15 00 and the MiraCosta Graphics Guideline.

P. The low voltage and communication raceway systems, wiring and terminations.

1.05 QUALITY ASSURANCE

A. Provide a Tridium Niagara 4 Framework as the basis of the new IAS. All IAS field level control devices provided shall be BACnet BTL listed.

B. All microprocessor based control products used shall conform to BTL Certified Standards.

C. The use of all proprietary equipment specified for the Integrate Automation System (IAS) integration shall be limited to devices and systems for which non-proprietary software drivers are available for the proposed Tridium Niagara 4 Enterprise infrastructure platform. It is the Contractor’s responsibility to verify that the equipment manufacturers provide the appropriate interface boards as defined in these specifications and design drawings.

D. The contractor shall provide hardware and software components of the same manufacturer wherever possible.

E. The contractor shall use standard off-the-shelf components and/or products whenever possible. Custom products shall not be used unless approved prior to the installation.

F. Materials and equipment shall be catalogued products and shall be the manufacturer’s latest standard design that complies with the specification requirements. Where multiple units of the same type or function are required for this project, these units shall be products of a single manufacturer.

G. All equipment shall be manufactured, installed and tested to comply with the acceptance testing requirements specified herein.

H. Product Line Demonstrated History: The product line being proposed for the Project must have an installed history of demonstrated satisfactory operation for a length of one (1) year since date of final completion in at least ten (10) installations of comparative size and complexity. Submittals shall document this requirement with references.

I. The IAS and components shall be listed by the Underwriters Laboratories (UL 916) as an Energy Management System.

1.06 INSTALLER’S QUALIFICATIONS

A. Installation shall be performed by a District prequalified IAS contractor. Contact David Dunn, MiraCosta CCD Measure MM Bond Program Team, for the current list of prequalified IAS contractors.
B. Integration Engineer Qualifications: An integration Engineer shall oversee the design and installation of the integration system. The Integration Engineer shall have a minimum of five (5) years’ experience with the installing company at an equal level of responsibility. The Integration Engineer shall have completed factory training for certification for the design, installation, start-up, and commissioning of the integration components to be installed. The Integration Engineer shall have experience in completing a minimum of two projects of similar size with the type of integration system specified for this project. Removal or replacement of Integration Engineer shall be subject to the District’s approval.

C. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the manufacturer(s) on that product line for installation and configuration.

D. Programming Training: Individuals involved with programming the Site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the manufacturer(s).

1.07 SUBMITTALS

A. General: Submit under provisions of Division 01. In addition, an electronic version of the completed materials shall be provided on electronic media. Data can be in native file format or scanned where necessary. Provide a complete and comprehensive submittal package. Partial submittals shall not be accepted. Upon completion submit all compliance data and project record documents.

B. Preconstruction Submittals. Provide within 70 calendar days of contract award.

1. Qualifications: Key personnel qualifications as indicated for the appropriate items.

   a. Submit validation which indicates the successful completion of the Tridium Niagara 4 certification course.

   b. Submit resumes of installing staff indicating passing certificates for training on the BACnet line of controls to be installed as part of this project. Also include prior Instrumentation and Control experience.

   c. Submit an organizational diagram indicating the key technical staff proposed for the project including Project Manager, Application Engineer, Programmers, Superintendent, etc. Provide staff quantities to be assigned to the project. Provide contact information for Managers, Programmers, and Lead Technicians.

C. Construction Submittals

   1. None

D. Closeout Submittals

   1. DDC Operations and Maintenance Manual
a. Provide a written System Overview and Summary. The system overview and summary should be written descriptions of how each system operates, encompassing not only what is stated in the sequence of operations, but also including descriptions of any interlocks between systems (that are not covered in the sequences), fault conditions that require software resets (through the DDC system), fault conditions that require hardware resets (at the device), and any other descriptions of how the systems operate that are not covered in the sequences of operation. The system overview and summary should provide the data needed by the maintenance personnel to allow for the safe and efficient operation, maintenance, and repair of the system. It should be a quick reference for someone who has to respond to a trouble call, and should become the manual with which training can be conducted.

b. Preventative Maintenance Procedures: Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime. Provide a calibration records and list of set points.

c. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to District facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.

1.08 SYSTEM ARCHITECTURE

A. The system provided shall incorporate hardware and software resources sufficient to meet the functional requirements of these Specifications. The FAC LAN and DLN shall be based on industry standard open platforms as specified herein and utilize commonly available operation, management and application software. All software packages shall be licensed to the Owner to allow unrestricted maintenance and operation of the IAS. Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications, including but not limited to:

1. Network Operating software
2. Device Drivers and Plug-ins
3. File Server Software
4. Graphical User Interface (GUI) and Utility software
6. Original electronic media and licenses for all software packages utilized to implement the IAS

B. The system architecture shall provide a campus IAS network which is based on the Niagara 4 Framework and consists of an Ethernet-based, wide area network (WAN), a single Local Area Network (LAN) that supports JACES, AACs, ASCs, Operator Workstations (OWS), Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the existing IAS structure. The contractor shall utilize these components of the IAS for the scope of this project.

1. WAN: Internet-based shared network connecting multiple campus facilities with a central data warehouse and server, accessible via standard web-browser. This is an existing infrastructure and Contractor is required to perform the necessary configuration to connect to the central IAS Niagara 4 server.
2. Facility Local Area Network (FAC LAN): The FAC LAN shall be an Ethernet-based, 10/100/1000 Ethernet LAN connecting Local JACEs, IAS Server and OWSs. The FAC LAN serves as the backbone for the JACE’s, communications path and as the connection point to the WAN. Contractor shall provide this as a dedicated LAN for the control system. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 6 cable with switches and routers that support 1000base-T gigabit Ethernet throughput.

3. The FAC LAN must be installed in accordance with IEEE 802.3, TIA/EIA 568-B and TIA/EIA 569-A. The FAC LAN shall support multiple NCs and OWS.

4. Device Level Network (DLN): Network used to connect AACs and ASCs. These shall be Master Slave devices as defined in the BTL standard.

C. Dynamic Data Access: Data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely as defined in the point list schedules.

D. Remote Data Access: The system shall support the Internet Browser-based remote access to the building data.

E. Browser-based access: A remote/local user using a standard browser will be able access all control system facilities and graphics via the WAN or direct connection, with proper username and password. Only Internet browser-based user interfaces (HTML5, Java, XML, CCS3 JAVA Script, etc.) are acceptable. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

F. The communication speed between the controllers, LAN interface devices, CSS, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Contractor shall submit guaranteed response times with Shop Drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall reconfigure LAN as necessary to accomplish these performance requirements:

1. 5 seconds between an operator selection of a graphic and it completely painting the screen and updating a minimum of forty (40) points.

2. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.

3. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.

4. 20 seconds between a Level 3-5 alarm occurrence and enunciation at operator workstation.

5. 10 seconds between an operator command via the operator interface to change a setpoint and the subsequent change in the controller.

6. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.

7. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
G. Tridium Niagara 4 Control Systems Server (CSS): A server that maintains the systems configuration and programming database. It holds the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It also acts as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information. The Contractor shall provide all required programming and configuration of the CSS to integrate the project facility into the IAS campus network.

H. The Operator Interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. The system shall be capable of supporting an unlimited number of clients using standard Web browsers including Internet Explorer™, FireFox™ and Chrome™.

I. The PCUs, AACs, ASCs, BCs, and SDs shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other PCUs, AACs, or ASCs and operator interface devices.

J. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on a server that resides on the FAC LAN. User tools for DLN and FAC LAN management shall be provided and licensed to the Owner and shall allow unrestricted configuring, updating, maintaining, and expanding of all current devices, configurations and settings.

K. Database Schema shall be published and provided to the Owner to facilitate easy access to DLN and FAC LAN data.

L. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

1.09 SUBSTITUTIONS

A. Wherever the words “for review” or “for acceptance” are used in regard to manufactured specialties, or wherever it is desired to substitute a different make or type of apparatus for that specified, submit all information pertinent to the adequacy and adaptability of the proposed apparatus to the Owner’s Representative and secure their approval before the apparatus is ordered. Refer to general condition requirements for substitutions.

B. Wherever system performance such as material quantities, operating pressure, network throughput, or the like are specified, or a definite make and size of apparatus is specified, for which such quantities are readily determinable, the make and size of the apparatus proposed must conform substantially to the quantities specified or implied. Critical dimensions relating to the installation of apparatus and coordination with the rest of the system shall be considered and adhered to. Substitution of equipment or apparatus shall include all necessary revisions and their costs required to complete the installation.

C. Approval of request for substitutions may be given only after receipt of complete and satisfactory performance data covering the complete range of operating conditions in tabular and graphical form. Furnish complete and satisfactory information relative to equipment performance, features and accessories, etc. Additional construction and design costs incurred as a result of any accepted substitution shall be borne by the Contractor.

D. Substitution Format: Proposed changes and substitutions of systems, apparatus, equipment and manufacturers will be considered subject to the approval of Owner’s representative. The proposal shall include the following information:

1. A description of the difference between the existing contract requirements and that proposed, the comparative features of each, and the effect of the change on the end result performance. Include the impact of changes on other Contractors and/or subcontractors and acknowledge the inclusion of implementation costs.
2. Schematic drawings and details to supplement the descriptions.

3. A list of the contract requirements that must be revised if the change is accepted, including any suggested specification revisions.

4. Complete list of materials and equipment proposed for use in the change.

5. Include a description and estimate of costs Owner may incur in implementing the change, such as test, evaluation, operating and support costs.

6. A projection of any effects the proposed change would have on collateral costs to the Owner.

7. A statement of the time by which a contract modification accepting the change must be issued, noting any effect on the contract completion time or the delivery schedule.

8. A statement indicating the reduction to the contract price if the Owner accepts the change. The Contractor shall be responsible for appropriate modification of subcontractor.

1.10 CODES

A. Comply with all current codes, ordinances, regulations, and the California Building Code. In all cases of conflict between the work of this Division and the California Building Code, or omission of items required for code compliance, details shall be brought to the attention of the Owner or Owner Representative at the time of bid proposal submission. It is the Contractor's responsibility to identify any items of conflict or omission. These items shall be resolved prior to bid submission and included in the bid proposal price.

B. The IAS work shall comply with all applicable requirements of the following codes. The latest edition is assumed unless stated otherwise or as amended by the Local Code Authorities.

1. UL 864 – Control Units for Fire Protective Signaling Systems
2. UL 916 – Energy Management
3. NFPA 91A – Recommended practice for smoke control systems
4. ADA – Americans with Disabilities Act
5. UL 508A – Manufacturer listed control panel
6. EIA/TIA-568 – Commercial Building Wiring Standard
7. ASHRAE – American Society of Heating Refrigerating and Air Conditioning Engineers
8. ANSI/ASHRAE Standard 135-2008 BACnet

C. Where codes are listed herein, the applicable portions of the latest editions apply.

D. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.

E. Should any change in Drawings or Specifications be required to comply with regulations, the Contractor shall notify the Owner prior to execution of the work and wait for direction from the Owner.
1.11 REFERENCED STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 135-2012, BACnet – A Data Communication Protocol for Building Automation and Control Networks
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
5. American Refrigeration Institute (ARI)
7. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
8. EIA-232: Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
9. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
10. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems
11. EIA-472: General and Sectional Specifications for Fiber Optic Cable
12. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
13. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
14. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications
15. UL 916: Energy Management Systems
16. NEMA 250: Enclosure for Electrical Equipment
17. NEMA ICS 1: General Standards for Industrial Controls
18. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences
19. NFPA 70 National Electrical Code (NEC)
20. Instrument Society of America (ISA)
21. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
22. IEEE 802.3: CSMA/CD (Ethernet – Based) LAN
23. IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
24. Joint Industrial Council (JIC)
25. BACnet Testing Lab
26. Occupational Safety and Health Act (OSHA)
27. Federal Communications Commission Parts 15 and 16

1.12 COORDINATION OF WORK WITH OTHER TRADES

A. Examine and compare the Integrated Automation System (IAS) Specifications and Drawings with the Specifications and Drawings of the other trades and report any discrepancies between them to the Owner. Obtain the Owner’s written instructions for changes necessary in the IAS work. Install and coordinate the IAS work in cooperation with the Commissioning Authority and the other trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner approved by the Owner. All changes required in the work of the Contractor, caused by noncompliance with the specifications, shall be made at the Contractor’s expense.

B. Certain products, systems and interface devices may be provided by other trades. Examine the Contract Documents to ascertain the requirements to install, wire, program, commission, and/or interface to these systems. Particular attention must be paid towards the interface boards submitted by the various equipment providers. It is the IAS Contractor’s responsibility to verify the submitted interfaces will integrate properly into the IAS. Report any discrepancies to the Owner.

C. Carefully check space requirements with other trades to insure that all material can be installed in the allotted spaces, including above finished suspended ceilings and under floors.

D. Wherever work interconnects with work of other trades, coordinate with other trades and with the Owner’s representative to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all work items (valves, dampers, coils, etc.) in an accepted manner and notify the responsible trade to install access doors and panels at these locations. Provide notification in writing to both the contractor and the Owner of these locations.

E. Provide sleeves and conduit for passage of pipes, and wiring through structural masonry, concrete walls and floors, and elsewhere for the proper protection of the IAS work.

F. Coordinate, project and schedule work with other trades and with the Commissioning Authority in accordance with the construction sequence.

G. Adjust locations of panels, equipment, devices, and the like, to accommodate work and prevent interferences. Determine the exact route and location of each pipe, conduit or tubing prior to fabrication and installation.

1.13 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
1.14 MATERIALS AND EQUIPMENT
   A. Materials shall be new, the best of their respective kinds without imperfections or blemishes, and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where Drawings or Specifications specifically allow existing materials to remain in place.

1.15 UNIFORMITY
   A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION
   A. Examine areas and conditions under which control systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
   B. These specifications call out certain duties of the Contractor and any subcontractor(s). They are not intended as a material list of all items required by the Contract.

3.02 INSTALLATION
   A. Utilize licensed electricians for all new and retrofitted electrical distribution systems. Installations of high and low voltage systems shall be in accordance with all building code requirements. Obtain electrical permits, if required by local authorities.
   B. Provide related items and work indicated on the IAS Drawings and items and work called for in this Division of the Specifications. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete systems. Perform start up, configuration, programming and commissioning coordination on each control product and system to provide fully operable systems in accordance with the specified functional performance.
   C. Comply with Federal, State, Municipal and other applicable codes and ordinances. If any conflict arises between these Specification and Drawings, and codes and ordinances, immediately notify the Owner’s Representatives. Do not deviate from the Drawings and Specifications nor install any work which may be in conflict with codes and ordinances until the conflict is resolved and the solution accepted by the Owner.
   D. The IAS Drawings show the general arrangement of the respective systems. Follow these Drawings as closely as actual building construction and the work of other trades will permit. Provide devices, fittings, sensors, controllers, wiring and accessories, which may be required but are not shown on the Drawings or specified herein. The Contractor shall be responsible for achieving the sequence of operations and intent of the system design. Investigate conditions affecting the work and arrange the work accordingly. Provide modifications and accessories as may be required to meet such conditions.
   E. All installation shall be in accordance with manufacturer’s published recommendations.
   F. Limit LAN cable lengths to no longer than 80% of the longest dimension published by the manufacturer of the cable between the most remote network nodes.

3.03 DIGITAL CONTROL PANELS, CONTROLLER QUANTITY AND LOCATION
   A. Individual Digital Control Panels (DCP) are referenced to indicate allocation of points to each DCP and DCP location. Digital control panels shall consist of one or multiple controllers to meet requirements of this Specification.
B. Where a DCP is referenced, Contractor shall provide at least one (1) controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Contractor shall extend power to the DCP from an acceptable power panel. Furthermore, Contractor is responsible for ensuring adequate locations for the panels that do not interfere with other requirements of the Project and maintain adequate clearance for maintenance access.

C. Contractor shall locate DCPs as referenced. It is the Contractor's responsibility to provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.

3.04 NETWORK MANAGEMENT FUNCTIONAL REQUIREMENTS

A. The Contractor shall coordinate the setup and configuration of the IAS local area network hardware to permit the functional requirements of the IAS herein specified. The setup shall include as a minimum the following network management procedures:

1. Automatic backup of the DDC System database to appropriate media.
2. Program, load and debug all software installations.
3. Network user auditing routine.

3.05 SURGE PROTECTION

A. Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all NCs, operator interfaces, printers, routers and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10 percent above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.06 CONTROL POWER SOURCE AND SUPPLY

A. IAS Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Division 25 and the Drawings.

B. General requirements for obtaining power include the following:

1. In the case where additional power is required, obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 480V source, obtain power from the electrically most proximate 120v source fed from a common origin.

2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source of power as the equipment. If the equipment's control transformer is large enough and is the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls, or is too noisy for reliable control, provide a separate transformer.

3. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served.

4. Standalone Functionality: Refer to Section 25 14 00.

3.07 PRODUCT DELIVERY, STORAGE, HANDLING, PROTECTION AND CLEANING

A. All products and materials shall be new, clean, and free of defects, damage and corrosion.
B. Ship and store products and materials in a manner which will protect them from damage, weather, and entry of debris. Do not install damaged items - take immediate steps to obtain replacement or repair.

C. The Contractor shall provide adequate means for and shall fully protect all finish parts of the materials and equipment against damage from any cause during the progress of the work until final acceptance. All materials and equipment in storage and during construction shall be covered in such a manner that no finished surfaces will be damaged or marred, and all moving parts shall be kept clean and dry. The Contractor is responsible for providing storage of materials and equipment.

D. Equipment and accessories shall be thoroughly cleaned of cement, plaster, and other materials; grease and oil spots shall be removed with cleaning solvent and surfaces carefully wiped.

E. Panels housing electronic controllers shall be constructed so that the panel and associated wiring may be installed independent of the installation of the electronics. The installation of electronics shall be coordinated with other trades and construction schedules to avoid damage.

3.08 SITE CLEAN UP

A. At conclusion of each day's work, clean up and remove from the site all rubbish, debris and trash accumulated during the day as a result of work of the Contractor. Sidewalks and streets adjoining the property shall be kept broom clean and free of debris, rubbish, trash and obstructions of any kind caused by work of this Contract.

B. Upon completion of the work and at times during progress of the work when requested by the Owner, the Contractor shall remove all surplus materials, rubbish, and debris resulting from the operation, and shall leave the entire building and involved portions of the site, insofar as the work of the Contract is concerned, in neat, clean and acceptable condition as approved by Owner.

C. Marks on walls or ceiling tiles caused by the Contractor shall be cleaned by the Contractor. Ceiling tiles, drywall, carpet, paint, and all architectural finishes damaged by the Contractor shall be replaced by the Contractor.

END OF SECTION 25 00 00
SECTION 25 06 00
NETWORK SCHEDULING SOFTWARE FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. Related Specifications:
   1. Section 250000 - Integrated Automation Systems (IAS) for HVAC
   2. Section 250800 – Fault Detection and Diagnostics Software for HVAC
   3. Section 251400 – IAS Network Controllers for HVAC

1.02 SUMMARY

A. The existing campus 25 Live classroom scheduling software system and the project installed DDC control systems shall be integrated directly so that the scheduled room event reservations entered in the reservation system will automatically schedule the required HVAC systems to turn on and off for those events. The integration software shall be configured by the contractor to periodically query the current day’s event schedules and command the appropriate HVAC equipment for the scheduled rooms automatically without operator interdiction.

B. The contractor shall procure and install the software and link the schedules of DDC equipment serving spaces scheduled through the 25Live software to automatically place the associated equipment and zones in standby mode in between classes and/or events during normally occupied periods.

1.03 SUBMITTALS

A. General: Submit under provisions of Division 01. In addition, an electronic version of the completed materials shall be provided on electronic media. Data can be in native file format or scanned where necessary. Provide a complete and comprehensive submittal package. Partial submittals shall not be accepted. Upon completion submit all compliance data and project record documents.

B. Preconstruction Submittals.
   1. Product Data
      a. Submit product data of the scheduling integration software.
      b. Provide a network architecture indicating how the software will interface on MiraCosta’s network, the Niagara 4 server, and the 25 Live scheduling software.
PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, Federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 NETWORK SCHEDULING SOFTWARE

A. The network scheduling interface software shall be Events2HVAC. Events2HVAC is listed a sole source product in the District’s design and construction standards. Alternate products will not be considered acceptable.

B. Supported Reservation Systems

1. The interface software will support the following reservations systems and multiple instances of the same type of system:

   a. CollegeNet Resource25/25Live web services
   b. Ad Astra Information Systems
   c. eSPACE
   d. Asure ResourceScheduler
   e. ShelbyNext
   f. SimpleChurchCRM
   g. FellowshipOne Go
   h. Microsoft Exchange (via Room Resources)
   i. Google (G Suite) Business Calendar (via Room Resources)
   j. Google Personal Calendar
   k. Manual schedule import using CSV format
   l. Other open API systems

C. Minimum Features

   The interface software shall be programmed with the following minimum features.

   1. Commands to HVAC system points can be issued at any or all of the following instances during an event:

      a. Event Setup Start
      b. Event Setup End
      c. Event Start
      d. Event End
      e. Event Teardown Start
      f. Event Teardown Stop
      g. Zone First Start (Daily)
      h. Zone Last Stop (Daily)
      i. Zone First Setup Start (Daily)
      j. Zone First Teardown Stop (Daily)

   2. Each command to HVAC system points can be started in advance of the event (Pre-Start time)

   3. Each command to HVAC system points can be stopped after a period of time after the event ends (Post-Stop time)

   4. Multiple rooms shall be associated with a single HVAC equipment item or zone as indicated on the zoning plans.

   5. Multiple reservation systems or instances of reservation systems shall be queried for control of zones.
6. User defined password-based, role-based security

7. Software shall generate the following reports on demand or in PDF format
   a. Daily event report
   b. Daily equipment command report
   c. Room Assignment report
   d. Equipment Detail report

8. Software shall email users if any scheduled commands fail to get executed.

9. Software shall email users the Daily reports above.

10. Software can aggregate multiple reservation systems and multiple instances of a reservation system into common HVAC schedules

11. Software shall store locally at least 7 days of backup schedule data from the reservation system in the event of a loss of communication with the reservation system.

PART 3 - EXECUTION

3.01 HVAC IAS INTEGRATION

A. The contractor is responsible for exposing (serving) the integrated room HVAC equipment objects in the accepted protocol. The contractor shall ensure that the system has the necessary communications protocols enabled across the network to allow point discovery and point read/write operations to the integrated objects.

B. Example: If the BACnet/IP protocol is used, the controlled point objects must be visible and writeable from the integration software client. Also, a BBMD may need to be enabled and defined on the BACnet network to allow a BACnet client to discover objects over different LAN segments.

C. The contractor is responsible for selecting the appropriate point objects that would be integrated and defining the priority for the commands coming from the integration software. Any potential safety issues or mechanical issues that could result from commands coming from the integration server shall be addressed using additional HVAC logic or programming to prevent unintended operations.

D. The contractor is responsible for programming and documenting a reasonable switchover method from automatic scheduling (dynamic schedules) to default building schedules in the event of a problem with the integration server or communication between building controllers and the integration server (for communication loss, server failure, or user requirements, etc.). A schedule status signal or heartbeat signal at the integration server will be generated by the integration software for automating the switchover.

E. The contractor is responsible for providing a list of integration points for each zone in Excel or CSV file format that includes: point name, point type, rooms served, point ID, occupied Mode value, Unoccupied Mode value, priority for writing, and a typical pre-start time in minutes. This list shall be used by the contractor to map the reservation system rooms to the required points for control.

3.02 IT NETWORK INTEGRATION

A. The contractor is responsible for enabling necessary TCP/IP traffic to pass through any hardware firewalls, PC firewalls, switches and routers that may be between the integration server, the room scheduling system and the HVAC system.

END SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. This specification identifies the requirements for incorporating embedded Fault Detection and Diagnostics (FD&D) software across the IAS control system network. The purpose is to provide a consistent, standardized methodology for analyzing the historical trend database data points to identify and address faults or deficiencies associated with DDC automation systems. The purpose of the analytic software application is to analyze energy, and equipment operational data to identify faults and opportunities for improved performance and reduced energy use in the operation of building systems.

B. Fault Detection and Diagnostics (FD&D) analytic software application is to provide verification that energy conservation measures (ECM’s) are executing as expected through the analysis of energy usage at the point of use, identification of faults showing where control sequences are not functioning as prescribed, and identification of opportunities for improved performance in the operation of building systems.

C. Related Sections include the Following:
   1. Section 250000 – Facility Management and Control System
   2. Section 250600 - Network Scheduling Software for HVAC
   3. Section 250800 – Fault Detection and Diagnostics Software for HVAC
   4. Section 250900 – Chiller Plant Optimization Software
   5. Section 251400 – IAS Network Controllers for HVAC

D. Guideline B - IAS Point Tagging Requirements

1.02 DEFINITIONS

A. API Application Program Interface
B. CSV Comma Separated Value
C. EDI Electronic Data Exchange
D. DDC Facility Management and Control System
E. M&V Measurement and Verification
F. REST Representational State Transfer
G. SaaS Software as a Service
H. SQL Standard Query Language
I. XML Extensible Markup Language

1.03 SUBMITTALS

A. FD&D Graphics Submittal: A copy of each of the FD&D graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at
this stage with the only remaining changes to be based on review comments from the A/E
design team and/or Owner.

1. The graphics submittal is due within 90 days of the award of contract.

2. Include a minimum of 40 additional hours and two Owner meetings to revise graphics
   based on Owner and design team comments.

B. Shop Drawings: Shall include the following:

1. Product data.

2. A complete written Sequence of Operation describing each fault rule and its
   programming.

1.04 SOFTWARE LICENSE AGREEMENT

A. It is the Owner's express goal to implement an open system that will allow products from
   various suppliers to be integrated into a unified system in order to provide flexibility for
   expansion, maintenance, and service of the system. The Owner shall be the named license
   holder of all software associated with any and all incremental work on the project(s). In
   addition, the Owner shall receive ownership of all job specific configuration documentation,
   data files, and application-level software developed for the project. This shall include all
   custom, job specific software code and documentation for all configuration and programming
   that is generated for a given project and/or configured for use with the FD&D system. Any
   and all required IDs and passwords for access to any component or software program shall
   be provided to the Owner.

PART 2 - MATERIALS

2.01 MANUFACTURERS

A. The fault detection and diagnostics software shall be based on SkySpark from SkyFoundry,
   fully embedded into the DGLux graphical user interface as the Fault Detection and Diagnostic
   Software. Skyspark is listed a sole-source produc
   t in the District’s design and construction
   standards. Alternate products will not be considered acceptable.

1. SkySpark by SkyFoundry is a FD&D software where “rules” are created using text-
   based source code that automatically run against collected data. The software comes
   with a large library of pre-programmed analytic functions and mathematical
   algorithms. It employs semantic tagging, pattern recognition, functional rules
   processing and other techniques.

2.02 PLATFORM REQUIREMENTS

A. The software application shall provide the following features and capabilities as a minimum:

1. GUI Integration – The software front end shall be integrated and operated through
   the specified DGLux 5 user interface software. FD&D software which require a
   separate user interface or log-in are not acceptable. Also, It shall not be acceptable
   to provide stand-alone instances of the SkySpark software.

2. Operating Systems - The analytic software application shall operate on current
   versions of Windows and Linux operating systems.

3. Time series database - The analytic software application shall utilize a database
   technology designed for the efficient storage and analysis of large volumes of time
   series data. It shall not employ a relational database structure but shall instead use
   tagging to model and describe data and shall support the use of the open source
   tagging standard. The FD&D software application shall use tagging to model and
   describe data and shall support the use of the open source tagging standard Project
   Haystack. Refer to Guideline B.
4. Data Import - The analytic software application shall accept and normalize data from a variety of sources including SQL compatible data bases, CSV format files, XML format files or web services, and other EDI techniques. Once imported the software shall provide a unified data format to enable analytics algorithms to identify patterns across those different data sets. The software shall import data directly from the DDC SQL historian server.

5. Open interfaces - The analytic software application shall provide open, REST-based API’s to enable integration with third party software applications. The open APIs shall enable data to be entered/imported into the database, exported from the database, posting of analytic queries and output of analytic results. APIs shall be fully documented and available as part of the standard product.

6. Hosted – SaaS or local deployment. The analytic software application shall be deployed locally in the facility. Deployment shall not be a SaaS (Software as a Service) deployment model. Provider shall include 60 months of software subscription within the costs of their proposal.

B. Weather Data Service - The analytic software application shall include a built in subscription to a worldwide weather service providing weather data for all major metropolitan areas. Weather service shall provide an update frequency of at least every 3 hours.

1. Weather data shall include:
   a. Current temperature
   b. High temperature for the day
   c. Low temperature for the day
   d. Sunrise and sunset times
   e. Relative Humidity
   f. Degree days (heating and cooling with adjustable balance point value)

2. The weather service shall include a three day forecast and provide historical weather data extending back at least 1 year.

C. Email notification - The analytic software application shall provide automatic notification of detected issues via email.

1. Email notification services shall as a minimum provide:
   a. Immediate notification of detected issues
   b. Daily digest or summary of detected issues
   c. The ability to delineate which issue notifications are sent to which recipients down to the level of specifying individual issues are sent to individual recipients.

2.03 HARDWARE REQUIREMENTS

A. The FD&D software shall reside on the DDC server.

2.04 ANALYTIC RULES

A. Standard Analytic Functions - The analytic software application shall provide a library of standard analytic functions. The following standard analytical functions shall be developed and applied to all integrated systems at MiraCosta College:

1. Equipment Operation
   a. Simultaneous Heating and Cooling
   b. Short Cycling of Equipment
   c. Degradation of Heating or Cooling Performance
d. Non-Optimal Economizer Operation  
e. Non-Functioning Sensors  
f. Setpoints Overridden  
g. Equipment not Operating with Schedules  
h. Leaking Valves  

2. Energy Performance and M&V  
a. Deviation of Energy Intensity from Baselines or Goals  
b. Weather Normalization of Energy Use  
c. Energy Savings Compared to Baseline  

B. Custom Rule Development – Heating Hot Water Plants  
1. The following rules shall be applied to all heating hot water plants:  
a. Hot Water DP Setpoint Not Met  
b. Boiler Status Doesn't Match Command  
c. Hot Water Leaving Temp Setpoint Not Met  
d. Pump Speed Override  
e. Pump Speed Doesn't Match Command  
f. Pump Off When Commanded On  
g. Pump On When Commanded Off  
h. HHW Broken Valves and sensors  
i. HHW Outdoor air temperature set-point optimization  
j. HHW equipment-short cycling  

C. Custom Rule Development – Packaged DX Rooftop Unit  
1. The following rules shall be applied to all air handling units:  
a. Simultaneous Heating and Cooling  
b. Cooling & Heating Lockouts Overlap  
c. Analog Damper Control Oscillation  
d. Low Temp Drop Across Cooling Coil  
e. Cooling Capacity Not Met  
f. Cooling OSAT Lockout Failure  
g. Damper Not Sealing  
h. DAT Hunting  
i. No Discharge Static Reset  
j. No Discharge Air Reset  
k. Outdoor Damper Closed, MAT Not Equal to RAT  
l. Outdoor Damper Open, MAT Not Equal to OAT  
m. Return Damper Doesn't Match Command  
n. AHU Economizer Issue - At Low OAT
o. Mixed Air Too High/Low
p. AHU Economizer Issue - At Mid OAT
q. AHU Economizer Issue at High OAT
r. Faulty Econ and Cooling
s. faultyDATreset
t. Outside Air Greater Than Needed
u. Relief Damper Out of Range
v. Mixed Air Temp Sensor Failure
w. Mixed Damper Out of Range
x. Outside Air Temp Sensor Failure
y. Outside Damper Out Of Range
z. Return Air Temp Sensor Failure
aa. Return Damper Out Of Range
bb. Supply Pressure Sensor Failure
c. Supply Air Temp Sensor Failure
dd. Relief Damper Doesn't Match Command
e. Relief Fan Status Doesn't Match Command
ff. Static Pressure> Setpoint, Fan Speed High
gg. Duct Pressure Greater Than Setpoint
hh. Supply Pressure Setpoint Not Met
ii. Supply Temp Setpoint Not Met
jj. Supply Air Temp Too Warm
kk. Supply Fan At Max And Duct Pressure Low
ll. Supply Fan Speed Doesn't Match Command
mm. Constant VFD Speed
nn. Broken Fan Belt
oo. Supply Fan And Outdoor Damper Mismatch
pp. Supply Fan Off When Commanded On
qq. Supply Fan On When Unoccupied
rr. Supply Fan On When Commanded Off
ss. Unoccupied AHU Operation
tt. AHU Loose Fan Belt
uu. AHU Fan Failures
vv. AHU Poor Scheduling
ww. AHU Valve and Fan Speed Cycling

D. Custom Rule Development –Terminal Air Units

1. The following rules shall be applied to all fan coils:
a. Analog Damper Control Oscillation
b. Hot Water Valve Out of Range  
c. DAT Hunting  
d. Zone Pressure Sensor Failure  
e. Zone Air Temp Sensor Failure  
f. HW Valve Doesn't Match Command  
g. Hot Water Valve Leak  
h. Terminal Broken sensors  
i. Terminal Poor scheduling  
j. Terminal Poor Temperature Set Points  
k. Terminal Extraneous reheat  
l. Terminal low or unbalanced air flow  

2.05 REPORTING  
A. Standard Views of Analytic Results - The analytic software application shall include standard views to present analytic results, which shall be automatically generated when issues are found by analytic rules.  
B. These views shall include as a minimum:  
   1. All rule violations across a portfolio of sites, all rules violations per site, including time, date and duration of all violations.  
   2. The ability to assign cost relationships to rule logic to provide cost per violation.  
   3. Standard filters to enable the user to easily look at rule violations by site, data, violation type for any selected date or date range.  
   4. Automatic calculation and presentation of Key Performance Indicators. It shall be possible to define custom KPIs as needed.  
C. Custom Views of Analytic Results  
   1. The analytic software application shall allow for the creation of custom reports and data views. Any standard system view shall be able to be saved as a custom report including its configuration criteria, e.g., time range, sites, rule violations or other configuration options as applicable to the standard system view.  
   2. Custom reports shall be able to be created by making queries against the database and saving the query as a saved report. Saved reports shall be able to be executed by typical system users with a single mouse click.  
   3. Exporting - The system shall allow for the export of any and all report views and shall support export in CSV, Excel, XML and HTML format. Export of report views shall be a feature available to the typical operator and be able to be accomplished with 2-3 mouse clicks.  

PART 3 - EXECUTION  
3.01 WIRING  
A. All electrical control wiring and power wiring to the FD&D, computers and network components shall be the responsibility of the FD&D contractor.  
B. The contractor shall furnish all power wiring to FD&D controllers.  
C. All wiring shall be in accordance with the National Electrical Code and any applicable local codes. All FD&D wiring shall be installed in the conduit types allowed by the National
Electrical Code or applicable local codes. Where FD&D CS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

3.02  WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the contractor at no expense to the Owner.

3.03  WARRANTY ACCESS

A. The Owner shall grant to the contractor, reasonable access to the FD&D system during the warranty period. The owner shall allow the contractor to access the FD&D system from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.04  SOFTWARE LICENSE

A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

B. The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner.

3.05  ACCEPTANCE TESTING

A. Upon completion of the installation, the contractor shall load all system software and start-up the system. The contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

B. The contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FD&D system operation.

C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

D. System Acceptance: Satisfactory completion is when the contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.06  OPERATOR INSTRUCTION, TRAINING

A. During system commissioning and at such time acceptable performance of the FD&D system hardware and software has been established the contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done in series with the required DDC system training and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. The contractor shall provide 12 hours of instruction to the owner's designated personnel on the operation of the FD&D and describe its intended use with respect to the programmed
functions specified. Operator orientation of the FD&D system shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

C. The training shall be in two sessions as follows:

1. Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

2. First Follow-Up Training: One half-day (4 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Related Specifications:
   1. Section 250000 – Integrated Automation Systems (IAS) For HVAC
   2. Section 251400 – IAS Network Controllers for HVAC

1.02 SUMMARY
A. Contractor shall supply and install the components listed in this section, and those identified on the project drawings, in adequate quantities as required to meet the sequence of operation and the design/performance intent of the MEP systems as they pertain to the IAS and the functional operation of the project as a whole.

B. Provide products compliant with the following sections for all devices specified and as indicated on the project drawings. If substitutions are necessary or warranted, follow the substitution submittal procedure defined in the project specifications. This section shall address the product requirements for the following components.
   1. Wiring
   2. Control Valves and Actuators
   3. Control Dampers and Actuators
   4. Control Panels
   5. Sensors
   6. Electric Control Components (Switches, EP Valves, Thermostats, Relays, etc.)
   7. Transducers
   8. Current Switches
   9. Thermowells
   10. Power Meters
   11. Nameplates
   12. Testing Equipment

C. Provide the following electrical work as work of this Section, complying with requirements of Division 26 Sections.
   1. Control wiring between field-installed controls, indicating devices, and unit control panels.
2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.

3. Wiring associated with annunciator and alarm panels (remote alarm panels) and connections to their associated field devices.

4. All other necessary wiring for a fully complete and functional control system as specified.

D. Refer to other Division 20 and Division 23 Sections for installation of instrument wells, valve bodies, and dampers in mechanical systems.

1.03 SUBMITTALS

A. General: Submit under provisions of Division 01. Provide a complete and comprehensive submittal package. Partial submittals shall not be accepted. Upon completion submit all compliance data and project record documents.

B. Preconstruction Submittals.

1. Control Devices Product Data: Submit manufacturer’s technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes.

a. Provide a list of devices in schedule form on 8½ x 11 sheets. The schedule shall be organized by columns to define all new devices to be installed as part of the IAS system installation including the location, system served, controlling unit, model number, performance data, size, range, accuracy, span, operating pressure, etc.:

   i. Control Valves
   ii. Automatic Dampers
   iii. Temperature Sensors
   iv. Access Doors
   v. Humidity Sensors
   vi. Air Quality Sensors
   vii. Smoke Detectors
   viii. Carbon Monoxide Detectors
   ix. Pressure Transducers and Transmitters
   x. Electric to Pneumatic Transducers
   xi. Digital Control Panels
   xii. Relay Contactors
   xiii. Energy Meters

b. Submit detailed cut sheets indicating the features, accessories and sub-assemblies of the following, or similar, as required:

   i. All ancillary devices including temperature sensors, flow sensors, and the like, including thermal wells where necessary
ii. Pressure gauges, thermometers and indicating devices where shown on the drawings

iii. Transformers required for control devices

iv. Relays

v. Electrical enclosures and back-plates

vi. Wire for DLN, FAC LAN, and all sensors and actuators

vii. FAC LAN Hub(s), Switches, and Routers

viii. DLN Repeaters

ix. Gateway and interface devices

2. Schedule of control dampers including leakage and flow characteristics.

3. Schedule of control valves including pressure drop, Cv, leakage, and flow characteristics.

1.04 REFERENCED STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. All control devices shall be electronic using DDC control unless specified on the drawings.

C. Provide electronic and electric control products in sizes and capacities indicated, consisting of valves, dampers, controllers, sensors, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

2.02 MATERIALS AND EQUIPMENT

A. Communication Wiring: All wiring shall be in accordance with the latest edition of the National Electrical Code and Division 26. Communication wiring shall be provided in a customized color jacketing material. Material color shall be as submitted and approved by Owner. Each end of the wire, originating and terminating end shall have a unique label identifying the purpose of the wire. An example of the required submittal and the application is provided below:

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Function</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Communications DLN</td>
<td>Field Device Communication</td>
<td>Red / Pink</td>
</tr>
<tr>
<td>Spare Primary</td>
<td>Field Device</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
1. **Device Level Network (DLN):** Contractor shall supply all communication wiring between JACE Controllers, Routers, Gateways, AAC’s, ASC’s, RIO’s and local and remote peripherals.

2. **Local Supervisory Facility LAN (FAC LAN):** For any portions of the FAC LAN required under this Section of the Specification, Contractor shall follow the requirements of Division 26 specifications. Network shall be run with no splices and separate from any wiring over thirty (30) volts.

3. **Primary (Master) and Secondary (Slave or Spare) Controller DLNs:** Communication wiring shall be individually 100 percent shielded per manufacturer’s recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated. DLN wiring shall be run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by building controller manufacturer.

**B. Signal Wiring:** Contractor shall run all signal wiring in accordance with the latest edition of the National Electrical Code and Division 26.

1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100 percent shielded pair, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.

2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

**C. Low Voltage Analog Output Wiring:** Contractor shall run all low voltage control wiring in accordance with the latest edition of the National Electrical Code and Division 26.

1. Low voltage control wiring shall be twisted pair, 100 percent shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices and separated from any wiring above thirty (30) volts.

**D. Control Panels:** Refer to section 25 14 00.

<table>
<thead>
<tr>
<th>Communication DLN</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Communications DLN</td>
<td>Equipment Integration Orange</td>
</tr>
<tr>
<td>Spare Secondary Communication DLN</td>
<td>Equipment Integration Purple</td>
</tr>
<tr>
<td>FACLAN</td>
<td>Enterprise Network</td>
</tr>
<tr>
<td>Spare FACLAN</td>
<td>Enterprise Network</td>
</tr>
<tr>
<td>Analog Points</td>
<td>I/O Wiring</td>
</tr>
<tr>
<td>Digital Points</td>
<td>I/O Wiring</td>
</tr>
<tr>
<td>Emergency Power</td>
<td>Control power</td>
</tr>
<tr>
<td>24VAC</td>
<td>Control power</td>
</tr>
</tbody>
</table>
2.03 STANDARD SERVICE CONTROL VALVES

A. General:
1. Provide factory fabricated control valves of type, body material and pressure class indicated.
2. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system.
3. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve.
4. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application.
5. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

B. Globe Valves:
1. Application: Modulating control valves up 8” for chilled water, heating hot water, and condenser water applications. Modulating control valves for air handling unit chilled and hot water coils.
2. Valve Sizing: 3-6 psig pressure drop at design flow rate.
3. Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on ‘top-and-bottom’ guided plugs.
4. Double Seated (Three-way) Valves: Valves shall have linear characteristics. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on ‘top-and-bottom’ guided plugs.
5. Temperature Rating: 25 degrees F minimum, 250 degrees F maximum
6. Body: Bronze, screwed, 250 psi maximum working pressure for ½ inch to 2 inch; Cast iron, flanged, 125 psi maximum working pressure for 2-1/2 inches and larger.
7. Valve Trim: Bronze; Stem: Polished stainless steel
8. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting
9. Plug: Brass, bronze or stainless steel, Seat: Brass
10. Disc: Replaceable composition or stainless steel filled PTFE
11. Ambient Operating Temperature Limits: -10 to 150 degrees F (-12.2 to 66 degrees C)
12. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
   a. Johnson Controls
   b. Honeywell
C. Ball Valves:

1. Application: Modulating control valves up to 2" for terminal unit and fan coil unit heating hot water and chilled water valves.
2. Body: Brass or bronze; one-, two-, or three-piece design; threaded ends
3. Seat: Reinforced Teflon
4. Ball: Stainless steel
5. Port: Standard or ‘V’ style
6. Stem: Stainless steel, blow-out proof design, extended to match thickness of insulation
7. Cold Service Pressure: 600 psi WOG
8. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
   a. Johnson Controls
   b. Honeywell
   c. Warren
   d. Belimo
   e. Siemens
   f. Approved equal

D. Butterfly Type: To be used for two-position control and modulating applications above 8" only, unless prior approval is obtained from Owner.

1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges
2. Seat: EPDM, except in loop bypass applications where seat shall be metal to metal
3. Disc: Bronze or stainless steel, pinned or mechanically locked to shaft
4. Bearings: Bronze or stainless steel
5. Shaft: 416 stainless steel
6. Cold Service Pressure: 175 psi
7. Close Off: Bubble-tight shutoff to 150 psi
8. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more than 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no cost to the Owner.
9. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
   a. Keystone
   b. Honeywell
   c. Bray Series 31
   d. Dezurik BGS
   e. Approved equal

2.04 CONTROL DAMPERS

A. General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable airflow. Provide parallel or opposed blade dampers as recommended by manufacturer's sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan di

B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 fpm (7.62 m/s), differential pressure not greater than 2.5 inches w.c. (622 Pa):
   1. Performance: Test in accordance with AMCA 500.
   2. Frames: Galvanized steel, 16-gage minimum thickness, welded or riveted with corner reinforcement.
   3. Blades: Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts with set screws, 16 gage minimum thickness.
   6. Shaft Bearings: Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.
   7. Linkage: Concealed in frame.
   8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
   9. Leakage: Less than one percent based on approach velocity of 1500 fpm (7.62 m/s) and 1 inches wg. (249Pa).
   11. Temperature Limits: -40 to 200 degrees F (-40 to 93 degrees C).
   12. Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.

C. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6 inches w.c. (1493 Pa):
   1. Performance: Test in accordance with AMCA 500.
2. Frames: Galvanized steel, 16-gage minimum thickness, welded or riveted with corner reinforcement.

3. Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts, 14 gage minimum extrusion thickness.


6. Shaft Bearings: Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.

7. Linkage: Concealed in frame.

8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.

9. Leakage: Less than 0.1 percent based on approach velocity of 4000 fpm. (20.3 m/s) and 1 inches wg. (249Pa).


11. Temperature Limits: -40 to 200 degrees F (-40 to 93 degrees C).

12. Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for the installation.

D. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 12 inches w.c.:

1. Performance: Test in accordance with AMCA 500.

2. Frames: Galvanized steel, 12-gage minimum thickness, welded or riveted with corner reinforcement.

3. Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 3/4 inch (19 mm) shafts with set screws.

4. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.

5. Linkage: 10-gage minimum thickness galvanized steel clevis type crank arms, 3/16 inch x 5/16 inch (4.76 mm x 19 mm) minimum thickness tie rods.

6. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.

7. Leakage: Less than 0.2 percent based on approach velocity of 4000 fpm (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.


9. Temperature Limits: -40 to 300 degrees F (-40 to 149 degrees C).

10. Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for the installation.
E. For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm (12.7 m/s), differential pressure not greater than 4 inches w.c. (994 Pa):

1. Performance: Test in accordance with AMCA 500.
2. Frames: Rolled 12 gage steel strip for sizes 6 inch and smaller, rolled 14 gage steel channel for larger sizes, galvanized or aluminum finish.
3. Blades: Steel construction, 12 gage minimum thickness for dampers less than 18 inches (457 mm) in size, 10 gage minimum thickness for larger dampers.
5. Shaft: ½ inch (12.7 mm) diameter zinc or cadmium plated steel.
6. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
7. Leakage: Less than 0.2 percent based on approach velocity of 4000 fpm (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
9. Temperature Limits: -40 to 300 degrees F (-40 to 149 degrees C).

F. For general isolation and modulating control service in round ducts up to 60 inches in size at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6 inches w.c. (1492 Pa):

1. Performance: Test in accordance with AMCA 500.
2. Frames: Rolled 10-gage steel channel for sizes 48 inch and smaller, rolled 3/16 inch (4.76 mm) thick steel channel for larger sizes, galvanized or aluminum finish.
3. Blades: Steel construction, 10-gage minimum thickness for dampers not greater than 48 inches in size, ¼ inch (6.35 mm) minimum thickness for larger dampers.
4. Blade stops: ½ inch x ¼ inch (12.7 mm x 6.35 mm) full circumference steel bar.
6. Shaft: Zinc or cadmium plated steel, angle reinforcing as necessary.
7. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
8. Leakage: Less than 0.4 percent based on approach velocity of 4000 fpm (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
10. Temperature Limits: -40 to 250 degrees F (-40 to 121 degrees C).
2.05 ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied. Manual override shall allow the user to disengage the valve/damper from the actuators motor for manual operation. Large valve actuators shall provide fly wheel for manual operation.

B. Actuators General Requirements:

1. Ambient Operating Temperature Limits: -10 to 150 degrees F (-12.2 to 66 degrees C).

2. Two Position Electric Actuators: Line voltage (120 volt, 24 volt) with spring return. Provide end switches as required.

3. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-5 VDC, 0-10 VDC, 2-10VDC, 4-20 mA, as required. Actuators shall travel full stroke in less than 90 seconds. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have positive positioning circuit. Where two actuators are required in parallel or in sequence provide an auxiliary actuator driver. Actuators shall have current limiting motor protection. Actuators shall have manual override where indicated. Modulating actuators for valves shall have minimum range of 40 to 1.

4. Close-Off Pressure: Provide the minimum torque required, and spring return for failsafe positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.

5. Manufacturer shall provide a 2 year unconditional warranty from date of substantial completion.

6. Sound levels for VAV actuators shall not exceed 45 dB.

7. Electronic overload protection shall protect actuator motor from damage. If damper jams actuator shall not burn-out. Internal end switch actuators are not acceptable.

8. Subject to compliance with requirements, approved manufacturers are as follows:
   a. Siemens
   b. Distech
   c. Belimo
   d. Johnson Controls
   e. Honeywell
   f. Approved equal

C. Control Dampers Actuators:

1. OA (outside air), RA (return air), and EA (exhaust air) actuators shall be spring return type for safety functions. Individual battery backup or capacitor return is not acceptable.
2. The control circuit shall be fully modulating using 2-10 volt or 4-20 mA signals. Accuracy and repeatability shall be within $\pm 1/21$ of control signal. A 2-10 v or 4-20 mA signal shall be produced by the actuator which is directly proportional to the shaft clamp position which can be used to control actuators which are paralleled off a master motor or to provide a feedback signal to the automation system indicating damper position. Accuracy shall be within $\pm 2.5\%$.

3. Stroke: 90 seconds end to end full stroke, 15 seconds return to normal for spring return, field selectable rotational/spring return direction.


6. Duty cycle: rated for 65,000 cycles.

7. Face and bypass dampers and other control dampers shall be modulating using the same control circuit detailed above but shall not be spring return.

D. Miscellaneous Damper Actuators:

1. OA combustion and ventilation air intake and EA damper actuators shall be 2 position spring return closed if any water piping, coils or other equipment in the space which the damper serves needs to be protected from freezing. Otherwise drive open, drive closed type 2 position may be used. The minimum torque for any actuator shall be 5 N-m.

2. Provide auxiliary switches on damper shaft or blade switch to prove damper has opened on all air handling equipment handling 100% outside air and greater than 6 KPa TSP.

E. Air Terminals:

1. Air terminal actuators shall be minimum 5 N-m torque and use fully modulating, floating (drive open, drive closed), 3 wire control or use control circuit as detailed in control dampers depending on the controller’s requirements. Noise level shall not exceed 45dB. Life cycle shall be a minimum of 60,000 cycles and 1.5 million repositions. Actuator Power consumption shall not exceed 4VA.

F. Control Valve Actuator General Requirements

1. Electric:
   
a. Gear Train: Motor output shall be directed to a self-locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.

b. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure.

c. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.

d. Enclosure: Actuator enclosure shall be a NEMA 4 epoxy coated metal enclosure, and shall have a minimum of two threaded conduit entries.

e. Limit Switches: Travel limit switches shall be UL approved. Switches shall limit actuator in both open and closed positions.

f. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
g. Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.

h. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.

i. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.

j. Position Controller: For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 VDC, 2-10 VDC, and 135 Ohm potentiometer.

k. Ambient Conditions: Actuator shall be designed for operation from –140 to 150 degrees F ambient with 0 to 100 percent relative humidity.

l. Field selectable direction with field adjustable zero span.

G. Electric Control Valves Actuators 4 inches and larger:

1. The valve actuator shall consist of a permanent split capacitor, reversible type electric motor which drives a compound epicycle gear. The electric actuator shall have visual mechanical position indication, readable from a distance of 25 feet, showing output shaft and valve position. Unit shall be mounting directly to the valves without brackets and adapters, or readily adapted to suit all other types of quarter-turn valves.

2. The actuator shall have an integral terminal strip, which, through conduit entries, will ensure simple wiring to power supplies. Cable entries shall have UL recommended gland stops within the NPT hole to prevent glands from being screwed in too far and damaging cable.

3. The actuator shall be constructed to withstand high shock and vibrations without operations failure. The actuator cover shall have captive bolts to eliminate loss of bolts when removing the cover from the base. One copy of the wiring diagram shall be provided with the actuator.

4. The actuator shall have a self-locking gear train which is permanently lubricated at the factory. The gearing shall be run on ball and needle bearings. Actuators with 620 in-lb or more output torque shall have two adjustable factory calibrated mechanical torque limit switches of the single-pole, double-throw type. The motor shall be fitted with thermal overload protection. Motor rotor shaft shall run in ball bearings at each end of motor.

5. For intermittent on/off service, the actuator shall be rated at a 20% duty cycle (i.e., 12 minutes extended duty in every hour, or alternatively; one complete cycle every 2 minutes). For more frequent cycling and modulating service, an actuator shall be rated for continuous duty. The actuator rated for continuous duty shall be capable of operating 100% of the time at an ambient temperature of 105°F.

6. The actuator shall have an integral self-locking gear train. Motor brakes shall not be required to maintain desired valve position. Levers or latches shall not be required to engage or disengage the manual override. Mechanical travel stops, adjustable to 15° in each direction of 90° rotation shall be standard, as well as two adjustable travel limit switches with electrically isolated contacts. Additional adjustable switches shall be available as an option.
7. Single Phase Motor: The motor shall have Class B insulation capable of withstanding locked-rotor for 25 seconds without overheating. Wiring shall also be Class B insulation. An auto-reset thermal cut-out protector shall be embedded in the motor windings to limit heat rise to 175°F in a 105°F ambient. All motors shall be capable of being replaced by simply disconnecting the wires and then removing mounting bolts. Disassembly of gears shall not be required to remove the motor.

8. Motor: Suitable for 120 or 240 volt single-phase power supply. Insulation shall be NEMA Class F or better. Motors shall have inherent overload protection.

9. Materials of Construction: The electric actuator shall have a pressure die-cast, hard anodized aluminum base and cover. The compound gear shall be made of die-cast, hard anodized aluminum or steel. An alloy steel worm gear shall be provided for manual override and torque limiting. Bearings for gears shall be of the ball and needle type; bronze bearings shall be used on the shafting parts.

10. Torque: Size for minimum 150% of required duty.

11. Potentiometer for providing continuous feedback of actuator position at the controller (for valves specified position feedback).

2.06 GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (RIO, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally ‘two-wire’ type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, is not designed to work with ‘two-wire’ type transmitters, if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide ‘four-wire’ type transmitters and necessary regulated DC power supply or 120 VAC power supply, as required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy and repeatability equal to, or better than, the accuracy and repeatability listed for respective field devices.

E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis.

F. Temperature transmitters shall be sized and constructed to be compatible with the medium to be monitored. Transmitters shall be equipped with a linearization circuit to compensate for non-linearity of the sensor and bridge to provide a true linear output signal.

G. Sensors used in energy or process calculations shall be accurate to ±0.10°C over the process temperature range. Submit a manufacturer's calibration report indicating that the calibration certification is traceable to the National Bureau of Standards (NBS) Calibration Report Nos. 209527/222173.

H. The following accuracy's are required and include errors associated with the sensor, lead wire and A to D conversion.
Point Type | Accuracy
--- | ---
Outside Air | 0.2 °C
Chilled/Hot Water | 0.2 °C
Room Temperature | 0.2 °C
Duct Temperature | 0.2 °C
Sensors Used in Energy Water (BTU) or Process | +/-1%

2.07 TEMPERATURE SENSORS (TS)

A. Sensor range: When matched with A/D converter of AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.3 degrees F (0.16 degrees C) (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25 degrees F over five (5) years.

B. Matched Sensors: The following applications shall require matched sensors:

1. Hydronic Temperature Difference Calculations: Provide matched supply and return temperature sensors where the pair is used for calculating temperature difference for use in load calculations or sequencing such as across chillers and plants. Sensing element shall be platinum RTD guaranteeing an accuracy of +/- 0.5 percent of span plus 0.1 degrees C.

2. Air Handling Unit Sequencing: Provide matched pair for the cooling and heating coil leaving sensors where the sequence includes calculating an offset from the supply air setpoint to maintain a leaving heating coil temperature. Sensing element shall be platinum RTD guaranteeing an accuracy of +/- 0.5 percent of span plus 0.1 degrees C.

C. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting, unless noted otherwise. Provide insulated base. The following sensing elements are acceptable:

1. Sensing element shall be thermistor (10K Ohm, Type II), +/- 0.1 degrees F accuracy at calibration point (10,000 Ohms @ 77 °F).

2. Sensing element shall be mounted in a plastic enclosure

3. Operating Temperature Range: -40 to 302 °F (-40 to 150 °C)

4. Operating Humidity Range: 0 to 90% RH non-condensing

5. Provide setpoint adjustment. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable or limited via the IAS.

6. Provide an occupancy override button on the room sensor enclosure. This shall be a momentary contact closure.

7. Provide current temperature indication via a backlit LCD or LED readout.

8. Provide unit heating and cooling status via the backlit LCD or LED readout.

9. Submit sensor to Architect for aesthetic and finish approval prior to installation.

10. Acceptable Manufacturers

   a. Match the manufacturer of the building Integrated Automation System
D. Standard Single-Point Duct Temperature Sensor: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated. Sensor probe shall be 316 stainless steel.

1. Sensing element shall be thermistor (10K Ohm, Type II), +/- 0.1 degrees F accuracy at calibration point (10,000 Ohms @ 77 °F).
2. Sensing element shall be encased in 4” or 8” stainless steel probe
3. Operating Temperature Range: -40 to 302 °F (-40 to 150 °C)
4. Operating Humidity Range: 0 to 90% RH non-condensing
5. Sensor stability +/- 0.13 °C Duct mount sensors shall mount in a hand box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A neoprene grommet (sealtite fitting and mounting plate) shall be used on the sensor assembly to prevent air leaks.
6. For outdoor air duct applications, use a weatherproof mounting box with weatherproof cover and gasket.

E. Standard Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area, or as recommended by manufacturer. Temperature range as required for resolution indicated.

1. Sensing element shall be thermistor (10K Ohm, Type II), +/- 0.2 degrees F accuracy at calibration point (10,000 Ohms @ 77 °F).
2. Sensing element shall be encased in 8' (4 sensing points), 12' (4 sensing points) or 24' (9 sensing points) long bendable copper sheath
3. Operating Temperature Range: -40 to 302 °F (-40 to 150 °C)
4. Operating Humidity Range: 0 to 90% RH non-condensing
5. Sensor stability +/- 0.13 °C
6. Provide capillary supports at the sides of the duct / coil to support sensing elements
7. Averaging Sensor shall traverse the width of the duct.

F. Liquid immersion temperature sensor shall include brass thermowell, sensor and connection head for wiring connections. Temperature range shall be as required for resolution of 0.15 degrees F.

1. Sensing element (chilled water/glycol systems) shall be platinum RTD +/- 0.2 degrees C measured at 0 degrees C.

G. Outside Air Sensors shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as require for resolution indicated in this Section.

1. Sensing element shall be thermistor (10K Ohm, Type II), +/- 0.2 degrees F accuracy at 0 to 70 °F.
2. Sensing element shall be encased in a weather proof enclosure which shall be designed to withstand the environmental conditions it will be exposed.
3. Provide a solar shield
4. Operating Temperature Range: -40 to 302 °F (-40 to 150 °C)
5. Operating Humidity Range: 0 to 90% RH non-condensing
6. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate surrounding the sensor element.
7. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

2.08 CARBON DIOXIDE SENSORS (CO2)

A. General: CO2 sensors shall use silicon based, diffusion aspirated, infrared single beam, dual-wavelength sensor.
   1. Listing: ETL
   2. Materials: Molded plastic enclosure
   3. Rating: 0 to 5000ppm
   4. Mounting: Duct or Wall as indicated
   5. Range: 0 to 2000ppm / 0-5000 User selectable
   6. Accuracy: +/- 36ppm at 800 ppm and 68 degrees F.
   7. Output: 0-10VDC, 4-20mA or alarm relay
   8. Stability: 5 percent over 5 years.

B. Acceptable Manufacturers:
   1. Vaisala, Inc. GMD20 (duct) or GMW20 (wall)
   2. Siemens
   3. Honeywell
   4. Approved equal

2.09 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)

A. General DP performance requirements
   1. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
   2. Pressure transmitters shall provide the option to transmit a 0 to 5V dc, 0 to 10V dc, or 4 to 20 mA output signal.
   3. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device and shall be supplied with shutoff and bleed valves in the high and low sensing pick-up lines (3 valve manifolds).
4. Provide a minimum of a NEMA 1 housing for the transmitter. Locate transmitters in accessible local control panels wherever possible. Provide tubing with rubber or neoprene grommet from panel to expose room conditions when necessary.

5. Low air pressure, differential pressure transmitters used for room pressurization control (i.e. laboratories, OR’s clean rooms, etc.) shall be equipped with a LED display indicating the transmitter output signal.

6. Duct sensing pressure applications where the velocity exceeds 1500 fpm shall utilize a static pressure traverse probes.

B. Liquid, Steam and Gas:

1. General: Two-wire smart DP cell type transmitter, 4-20 mA or 1-5 VDC linear output, adjustable span and zero, stainless steel wetted parts.

2. Ambient Limits: –40 to 175 degrees F (-40 to 121 degrees C), 0 to 100% RH.

3. Process Limits: –40 to 400 degrees F (-40 to 205 degrees C).

4. Accuracy: Less than 0.1 percent.

5. Output Damping: Time constant user selectable from 0 to 36 seconds.

6. Non-interactive zero and span adjustments adjustable from the outside cover.

7. Vibration Effect: Less than +/- 0.1 percent of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.


9. Approvals: FM, CSA.

10. Acceptable Manufacturers:
   a. Setra
   b. Honeywell
   c. Approved equal

C. General Purpose Low Pressure Air (0 – 125 Pa): Generally for each measurement of duct pressure, filter differential pressure or constant volume air velocity pressure measurement where the range is applicable. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the room and reference static pressure input signals with the following performance requirements.

1. General: Loop powered two-wire differential capacitance cell-type transmitter immune to shock and vibration

2. Switch shall be capable of Automatic Rest

3. Output: Two wire 4-20 mA output with zero adjustment.

4. Overall Accuracy: Plus or minus 0.5 percent of full scale

5. Dead Band: Less than 0.3% of output

6. Repeatability: Within 0.2% of output
7. Linearity: Plus or Minus 0.2% of span
8. Response: Less than on second for full span input.
9. Temperature Stability: Less than 0.05% of output shift per degree C change.
10. Minimum Range: 0.1 inches w.c.
11. Maximum Range: 10 inches w.c.
12. Housing: Polymer housing suitable for surface mounting.
13. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
14. Range / Span: Select for specified setpoint to be between 25 percent and 75 percent full-scale. Not greater than two time the design space DP.
15. Magnehelic Gauges: Provide Dwyer Series 200 Magnehelic Differential Pressure Gauge (or equal) for each DP transmitter. Provide gauge, mounting bracket, ¼ inch aluminum tubing, static pressure tips, and molded plastic vent valves for each gauge connection. Select range for specified recommended filter loading pressure drop to be 75 percent full-scale. For other DP transmitters select range for specified setpoint to be between 25 percent and 75 percent full-scale.
16. Acceptable Manufacturers:
   a. Setra
   b. Veris PX Series
   c. Dwyer Series 616
   d. Approved Equal

D. Medium to High Air Pressure Applications (125Pa to 2500 Pa): The pressure transmitter shall match the characteristics defined for low air applications with the modified performance criteria:
   1. Zero and Span (% F.S./ Deg C) shall be 0.05% including linearity, hysteresis and repeatability.
   2. Accuracy: 1% Full Scale (best straight line)
   3. Static Pressure Effect: 0.05% Full Scale (to 700 KPA)
   4. Thermal Effects: less then +/- 0.05% Full Scale / Deg C over 5C to 40C when calibrated at 22 deg C.
   5. Pressure switches shall be manually reset.

E. General Purpose Low Pressure/Low Differential Air: Generally for use in static measurement of space pressure or constant volume air velocity pressure measurement where the range is applicable.
   1. General: Loop powered, two-wire differential capacitance cell type transmitter.
   2. Output: Two-wire 4-20 mA output with zero adjustment.
   3. Overall Accuracy: Plus or minus 1 percent.
5. Maximum Range: 0.1, 0.25, or 0.5 inches w.c.
6. Housing: Polymer housing suitable for surface mounting.
7. Acceptable Manufacturers:
   a. Setra
   b. Honeywell
   c. Approved equal
8. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
9. Range: Select for specified setpoint to be between 25 percent and 75 percent full-scale.

F. VAV Velocity Pressure: Generally for use in variable volume air velocity pressure measurement where the range is applicable.
   1. General: Loop powered two-wire differential capacitance cell type transmitter.
   2. Output: Two-wire, 4-20 mA output with zero adjustment.
   3. Overall Accuracy: Plus or minus 0.25 percent.
   4. Minimum Range: 0 inches w.c.
   5. Maximum Range: 1 inch w.c.
   6. Housing: Polymer housing suitable for surface mounting.
   7. Acceptable Manufacturers:
      a. Setra
      b. Approved equal
8. Range: Select for minimum range that will accept the maximum velocity pressure expected.

2.10 AIRFLOW MEASURING STATIONS (AFMS). Air Flow Measuring Stations – Thermal Dispersion Type. The manufacturer’s authorized representative shall review and approve placement and airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting engineer if any measurement locations do not meet the manufacturer’s placement requirements.
   1. Each airflow measuring station shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor assemblies.
      a. Each sensor assembly shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
      b. Thermistors shall be mounted in the sensor assembly using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment.
c. The airflow rate at each sensor assembly shall be velocity weighted and averaged by the transmitter prior to output.

d. Each transmitter shall have a 16-character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics.

e. The Air Flow Measuring Station shall be approved by the manufacturer for the specific application. Contractor shall provide design parameters to the manufacturer for review and acceptance. Contractor shall provide proof of acceptance by manufacturer.

f. Acceptable manufacturers:
   i. Ebtron Gold Series with C sensor density probes
   ii. Approved equal

2. All sensor probes
   a. Each sensor shall independently determine the airflow rate and temperature at each measurement point.
   
   b. Each sensor shall be calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute and Standards and Technology (NIST).

   c. Airflow accuracy shall be ±2% of Reading over the entire operating airflow range.
   
   i. Devices whose accuracy is the combined accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.

   d. The operating humidity range for each sensor probe shall be 0-99% RH (non-condensing)

   e. Each sensor probe shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.

   f. Each sensor assembly shall not require matching to the transmitter in the field.

   g. A single manufacturer shall provide both the airflow measuring probe(s) and transmitter for each measurement location.

3. Duct and plenum probes
   a. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tube. All wires within the aluminum tube shall be Kynar coated.

   b. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:

   i. Insertion mounted through the side or top of the duct.
   ii. Internally mounted inside the duct or plenum.
   iii. Standoff mounted inside the plenum.
c. The number of sensor housings provided for each location shall be as follows:

<table>
<thead>
<tr>
<th>Duct or Plenum Area (sq. ft.)</th>
<th>Total Number of Sensors / Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2</td>
<td>4</td>
</tr>
<tr>
<td>2 to &lt;4</td>
<td>6</td>
</tr>
<tr>
<td>4 to &lt;8</td>
<td>8</td>
</tr>
<tr>
<td>8 to &lt;16</td>
<td>12</td>
</tr>
<tr>
<td>&gt;=16</td>
<td>16</td>
</tr>
</tbody>
</table>

d. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

B. Air Flow Measuring Stations – Piezometer Type: Wherever available from fan or air handling unit manufacturers, provide piezometer rings mounted at the throat and a static pressure tap mounted on the face of the fan inlet cone connected to a differential pressure transducer with digital display. The stations shall continuously measure the airflow through the inlet of the fan and transmit that information to the building automation system via 4-20 mA or 0-10 VDC signals. Overall accuracy of the flow measuring station shall be within 5% of actual air flow. Pressure drop shall not exceed .1” water gage.

2.11 DIFFERENTIAL PRESSURE SWITCHES (DPS)

A. All pressure sensing elements shall be corrosion resistant. Pressure sensing elements shall be bourdon tubes, bellows, or diaphragm type. Units shall have tamper-proof adjustable range and differential pressure settings.

B. Pressure sensor switch contacts shall be snap action micro-switch type. Sensor assembly shall operate automatically and reset automatically when conditions return to normal. Complete sensor assembly shall be protected against vibration at all critical movement pivots, slides and so forth.

C. Differential pressure switches shall be vented to withstand a 50% increase in working pressure without loss of calibration.

D. General Service Auto Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing.

1. Acceptable Manufacturer - Dwyer Series 1900 or approved equal.

E. General Service Manual Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing.

1. Acceptable Manufacturer - Dwyer Series 1900 or approved equal.

F. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range and 0 degrees F to 160 degrees F operating temperature range.
2.12 CURRENT SENSING RELAY (CSR)

A. Current Sensing switch shall be self-powered with solid-state circuitry and a dry contact output. Current sensing switch shall accept over current up to twice its trip range. Clamp-On Design Current Operated Switch (for Constant Speed Motor Status Indication):

1. Range: 2.5 to 135 amps
2. Trip Point: Adjustable
3. Switch: Solid state, normally open, 1.0A @ 30VAC/DC
4. Lower Frequency Limit: 6 Hz
5. Trip Indication: LED
6. Approvals: UL, CSA
7. Max. Cable Size: 350 MCM
8. Acceptable Manufacturers:
   a. Veris Industries H-908
   b. Approved equal

B. Clamp-on Wire Through Current Switch (CS/CR) (for Constant Speed Motors): Same as CSR with 24v command relay rated at 5A @ 240 VAC resistive, 3A @ 240 VAC inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A).

1. Acceptable Manufacturers:
   a. Veris Industries, Inc. Model # H938
   b. RE Technologies RCS 1150
   c. Approved equal
2. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing similar with override switch to Kele RIBX.

C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication:

1. Range: 3.5 to 135 Amps
2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz
3. Switch: Solid state, normally open, 0.1A @ 30VAC/DC
4. Frequency Range: 35 to 75 Hz
5. Trip Indication: LED
6. Approvals: UL, CSA
7. Max. Cable Size: 350 MCM
8. Acceptable Manufacturers:
   a. Veris Industries, Inc. H-904
D. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CSR with 24v command relay rated at 5A @ 240 VAC resistive, 3A @ 240 VAC inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A).

1. Acceptable manufacturers:
   a. Veris Industries, Inc., Model # H934
   b. Approved equal

E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.13 CURRENT TRANSFORMERS (CT)

A. The current transformers shall be designed to be installed or removed without dismantling the primary bus or cables.

1. The core and windings shall be completely encased in a UL approved thermoplastic rated 94VA. No metal parts shall be exposed other than the terminals.

2. The current transformers shall meet the following specifications:
   a. Frequency Limits: 50 to 400 Hz
   b. Insulation: 0.6 KV Class, 10 KV BIL
   c. Accuracy: ± .2% at 5.0 to 25.0 VA accuracy class with U.P.F. burden
   d. Range <1-10 Amps minimum, 20-200 amps> maximum
   e. Trip Point adjustable
   f. Output 0-5 VDC

3. Provide a disconnect switch for each current transformer

4. Protection: 250 A max current

5. Acceptable Manufacturers:
   a. Ohio, Semitronics Technologies Inc.
   b. Triad Technologies
   c. EMON
   d. Hawkeye
   e. Approved equal

2.14 MAGNETIC FLOW METER FOR WATER SERVICE

A. General Requirements:
1. Sensor shall be a magnetic flow meter, which utilizes Faraday’s Law to measure volumetric fluid flow through a pipe.

2. The flow meter shall consist of two (2) elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.

3. Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).
   a. Provide a four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube
   b. Output: 4-20 mA
   c. Flow Tube: Stainless steel
   d. Electrical Enclosure: NEMA 4, 7
   e. Approvals: UL or CSA
   f. Stability: 0.1 percent of rate over six (6) months
   g. Process Connection: Carbon steel, ANSI 150 LB, size as required

B. Meter Accuracy:
   1. Under the reference conditions of a 68 degrees F media temperature, a 68 degrees F ambient temperature, a +/- 1 percent nominal power supply voltage, 10 diameters upstream and 5 down of straight piping and a fully developed flow profile; the meter must meet the following requirements:
      a. Plus or minus 0.8 percent of reading accuracy in the flow range of 1.65 - 33 ft/sec
      b. Meter repeatability shall be +/- 0.1 percent of rate at velocities > 1.65 feet per second.
   
C. Calibration: The sensor must be calibrated on an internationally accredited (i.e. NAMAS) flow rig with accuracy better than 0.1 percent. Calibration shall be traceable to National Institute of Standard and Technology.

D. Construction:
   1. The meter piping material shall be AISI 304 stainless steel
   2. The meter flange and enclosure material shall be carbon steel
   3. The external surface of the sensor is to be treated with at least 0.006 inches (150 µm) of Corrosion resistant two-component paint
   4. The inner meter piping shall be protected with a neoprene liner or similar liner
   5. The electrode material shall be AISI 316 Ti or better
   6. The sensor be ANSI class 150 pounds

E. Electronics:
1. The sensor shall contain a SENSOR-PROM, storing calibration and factory default settings, i.e. the identification of the sensor and size

2. An ISO 9001 approved company shall manufacture the sensor and electronics

3. As standard, the electronics must be installable directly on the sensor or installable (remote) up to 1500 feet from the sensor as a maximum

4. With local electronics installation, the electronics shall be able to withstand three (3) feet water submersion for up to 30 minutes

5. The electronics shall be compatible with the following power specifications:
   a. 15/230 VAC +10 percent to 15 percent 50-60 Hz
   b. The power consumption must be 10 Watts or less independent of meter size

6. The meter electronics shall be able to produce simultaneous scalable current and frequency/pulse output. The frequency output shall be linearly proportional to flow rate and scalable from 0-10 kHz. The pulse output shall be scalable from 50 to 5000 milliseconds duration, suitable for an electromechanical totalizer in engineering units

7. The electronics must have an internal totalizer for summation of flow

8. The output of the electronics must be individually, galvanically isolated with an isolation voltage of more than 500 V

F. Output:
   1. The current signal must be either 0-20 mA or 4-20 mA proportional to the flow velocity
   2. The output current signal must accommodate 20 percent over range without loss in linearity
   3. The electronics shall have an alphanumeric LCD display showing actual flow and totalized flow in engineering units
   4. The display and keyboard must be rotatable so that the display can be viewed regardless of sensor orientation

G. Error Detection:
   1. The electronics must be able to detect the flowing error conditions:
      a. Signal connection between electronics and sensor interrupted
      b. Loss of current to the coil circuit
      c. Load on the current output
      d. Defective electronics
      e. Defective sensor
      f. Empty pipe
   2. The electronics must have an Error Log where all error conditions occurring within a period of 180 days are stored

H. Electronic Replacement Programming:
1. The electronics must be immediately replaceable without the need of cable disconnection or renewed configuration programming.

2. When the supply voltage is applied, the electronics must self configure and display flow without keyboard contact (no programming required).

3. The electronics must be provided with an automatic zero flow setting.

4. The electronics shall be programmable with respect to:
   a. User display options and menu
   b. Setting data
   c. Configuration of outputs
   d. Zero ‘cut-off’ from 0 percent to 9.9 percent of maximum flow

5. For ease of programming, the electronics shall be programmable away from the meter using the meter Sensor-Prom and a 9 V battery.

6. The electronics shall be suitable for operation in an ambient temperature range of -4 degrees F to 120 degrees F.

I. Acceptable Manufacturers:
   1. Engineering Measurements Co. (EMCO MAG 3100 with a model MAG 2500 electronic transmitter and display)
   2. Rosemont
   3. Toshiba
   4. Hersey Measurement
   5. Yokogawa Industrial Automation
   6. Endress & Hauser
   7. Approved equal

2.15 STRAP-ON AQUASTAT

A. UL listed, provided with a suitable removable spring clip for attaching aquastat to pipe and a snap-action SPDT switch. Switch setpoint shall be as indicated. Electrical rating shall be 5 amperes, 120 VAC.

2.16 ELECTRIC CONTROL COMPONENTS

A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley or approved equal.

B. Electric Solenoid-Operated Pneumatic Valves (EP): EP valves shall be rated for a minimum of 1.5 times their maximum operating static and differential pressure. Valves shall be ported 2-way, 3-way, or 4-way and shall be normally closed or open as required by the application. EPs shall be sized for minimum pressure drop, and shall be UL and CSA listed. Furnish and install gauges on all inputs of EPs. Furnish an adjustable air pressure regulator on input side of solenoid valves serving actuators operating at greater than 30 psig.

   1. Coil Enclosure: Indoors shall be NEMA 1, Outdoors shall be NEMA 3, 4, 7, 9.
2. Fluid Temperature Rating: Valves for compressed air and cold water service shall have 150 degrees F (66 degrees C) minimum rating. Valves for hot water or steam service shall have fluid temperature rating higher than the maximum expected fluid temperature.

3. Acceptable Manufacturers:
   a. ASCO
   b. Honeywell
   c. Approved equal

4. Coil Rating: EP valves shall have appropriate voltage coil rated for the application (i.e., 24 VAC, 120 VAC, 24 VDC, etc.).

C. Control Relays General:

1. Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.

2. Solid State Relays (SSR): Input/output isolation shall be greater than 10E9 ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz. The contact life shall be 10 x 10E6 operations or greater. The ambient temperature range of SSRs shall be -20 to +140°F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.

3. Contactors: Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contractor shall be double-break-silver-to-silver type protected by arcing contacts. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

D. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA 1 enclosure for indoor locations, NEMA 4 for outdoor locations.

1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
   a. AC coil pull-in voltage range of +10 percent, -15 percent or nominal voltage.
   b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
   c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
   d. Pilot light indication of power-to-coil and coil retainer clips.
   e. Coil rated for 50 and 60 Hz service.
   f. Acceptable Manufacturers:
      x. Potter Brumfield, Model KRPA
      xi. Approved equal
   g. Material: Gold Flash
h. Rating 10 amps at 120-277 VAC
i. Provide HOA switch except in smoke control applications.

2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 horsepower, and 1/3 horsepower, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC or approved equal.

3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.


F. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall have replaceable fuses in accordance with the NEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 enclosure.

1. Transformers shall be manufactured by <Westinghouse, Square ‘D’, Jefferson, or approved equal>.

G. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 VAC Sonalert solid-state electronic signal, as manufactured by <Mallory or approved equal>.

H. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 VAC operation. Switch shall be 800T type, as manufactured by Allen-Bradley or approved equal.

2.17 THERMOWELLS

A. When thermowells are required, the sensor and well shall be supplied as a complete assembly including well head and greenfield fitting, except where wells are to be installed under separate contract.

B. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.

C. Thermowells and sensors shall be mounted in a threadolet or 12.7 mm NPT saddle and allow easy access to the sensor for repair or replacement.

D. Thermowells shall be constructed of the following materials:

1. Chilled and Hot Water; brass.
2. Steam; 316 stainless steel.

2.18 ELECTRICAL POWER METERS

A. Electrical Meters

1. Advanced Digital Electrical meters shall meet the following requirements:
   a. Meter accuracy specifications shall comply with ANSI C12.20 Class 0.2% to 0.5% accuracy at 25°C.
b. Meter shall be UL certified.

c. Meter accuracy shall be + 0.5% for power measurements.

d. Capability to measure and record 15 minute interval data.

e. Capable of monitoring of: phase voltages, phase currents, power consumption, power factor, harmonics, power quality and kVAR.

2. Panel Mounted Power Meters <Verify the following specifications, modify as required>

a. The meter shall be UL listed and CE marked.

i. Power meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.

ii. Meter shall support 3 element wye, 2.5 element wye, 2 element delta, 4 wire delta systems.

iii. The meter shall accept universal voltage input.

iv. Surge withstand shall conform to IEEE C37.90.1.

v. The meter shall be user programmable for voltage range to any PT ratio.

vi. Meter shall accept a burden of up to .36VA per phase, Max at 600V, 0.014VA at 120 Volts.

3. Current and Potential Transformers

a. Current Transformers shall conform to the following requirements:

i. Insulation Class: All 600 volt and below current transformers shall be rated 10 KV BIL. Current transformers for 2400 and 4160 volt service shall be rated to 25 KV BIL.

ii. Frequency: Nominal 60 Hz

iii. Burden: Burden Class shall be selected for the load

iv. Phase Angle Range: 0 to 60 degrees

b. Provide a multi-ratio current transformer with a top range equal to or greater than the actual load. Select a ratio for each current transformer that matches the minimum and maximum power load.

c. Install Potential Transformers sized for the installed service voltage. Provide a disconnect switch (fuses) or a means to isolate the meter base from the voltage source without service shut-down.

d. Provide a disconnecting wiring block between the current transformer and the meter. A shorting mechanism shall be built into the wiring block to allow the current transformer wiring to be changed without removing power to the transformer. The wiring block shall be located where they are accessible without the necessity of disconnecting power to the transformers. For multi-ratio current transformers, provide a shorting block from each tap to the common lead.

4. Local EMCS controllers and local EMCS servers connected to meters with intent to communicate with utility or curtailment service provider programs such as Demand Response shall comply and be certified with ANSI C12.20 accuracy standard.
5. Miscellaneous
   a. Within one year after acceptance of Work, verify operation and recalibrate each meter in accordance with the manufacturer’s written instructions.
   b. The installation contractor shall affix labels to each meter, using a labeling nomenclature supplied by the Owner’s Representative. Label information shall correspond to meters indicated on the block diagram.

B. NATURAL GAS METERS
   1. Advanced Diaphragm gas meters shall meet the following requirements:
      a. Meter accuracy specifications shall comply with ANSI B109.2.
      b. Meter shall be UL certified.
      c. Meter capacity shall be listed for the maximum natural gas flow indicated in plumbing drawings.
      d. 25 PSIG (1724 mBar) Maximum Allowable Operating Pressure
      e. Provide remote volume pulser. Pulse output 12VDC max @ 10mA.
   2. Acceptable Manufacturers:
      a. Elster American Meter AC series.
      b. Approved equal

C. SIGNAL MULTIPLIER
   1. Signal Multipliers shall meet the following requirements:
      a. Multipliers shall be capable of four way electrical isolation of one input, two outputs, and power supply.
      b. Inputs shall have a range of either 0-24mA/ 0-12V, freely selectable in increments of 0.1 (mA/V). Contractor shall match the input signal.
      c. Calibrate the analog output signal scaling at each device separately.
   2. Acceptable Manufacturers:
      a. Phoenix Contact MCR-FL-C-UI-2UI-DCI
      b. Approved equal

2.19 NAMEPLATES
   A. Provide engraved phenolic or micarta nameplates for and field devices furnished>. Nameplates shall be 1/8 inch thick, black, with white center core, and shall be minimum 1 inch x 3 inch, with minimum ¼ inch high block lettering. Nameplates for devices smaller than 1 inch x 3 inch shall be attached to adjacent surface.
   B. Each nameplate shall identify the function for each device.
2.20 TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/- 0.5 percent accurate, test equipment shall be +/- 0.25 percent accurate over same range).

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner.

3.02 INSTALLATION OF CONTROL SYSTEMS <MODIFY AS REQUIRED TO MATCH PROJECT DESIGN>

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Installation shall be in accordance with manufacturer's published recommendations.

C. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of the latest edition of the National Electrical Code and all local codes.

D. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.

E. Averaging Temperature Sensors: Cover no more than three square feet per linear foot of sensor length except where indicated. Generally, where flow is sufficiently homogeneous/adequately mixed at sensing location, consult Engineer for requirements.

F. Airflow Measuring Stations: Install per manufacturer's recommendations in an unobstructed straight length of duct (except those installations specifically designed for installation in fan inlet). For installations in fan inlets, provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFM station manufacturer.

G. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.

H. Relative Humidity Sensors: Provide element guard as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.

I. Water Differential Pressure Transmitters: Provide valve bypass arrangement to protect against over pressure damaging the transmitter.

J. Pipe Surface Mount Temperature Sensors: Install with thermally conductive paste at pipe contact point. Where sensor is to be installed on an insulated pipe Contractor shall neatly cut insulation install sensor, repair or replace insulation and vapor barrier and adequately seal vapor barrier.
K. Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications.

L. Current Switches for Motor Status Monitoring: Adjust so that setpoint is below minimum operating current and above motor no load current.

M. Supply Duct Pressure Transmitters:
   1. General: Install pressure tips with at least four (4) ‘round equivalent’ duct diameters of straight duct with no takeoffs upstream. Install static pressure tips securely fastened with tip facing upstream in accordance with manufacturer’s installation instructions. Locate the transmitter at an accessible location to facilitate calibration.

   2. VAV System ‘Down-Duct’ Transmitters: Locate pressure tips approximately 2/3 of the hydraulic distance to the most remote terminal in the air system or as directed by the engineer and/or owner’s representative. Refer to IAS and mechanical drawings for more detail.

N. Cutting and Patching Insulation: Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

END OF SECTION 25 11 00
PART 1 - GENERAL

1.01 DESCRIPTION

A. This section defines the Basic Materials and Methods used in the installation of the INTEGRATED AUTOMATION SYSTEM (IAS).

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. Refer to Section 25 00 00 - Building Automation System (BAS) General for definitions and abbreviations.

D. Related Specifications:
   1. Section 250600 - Network Scheduling Software for HVAC
   2. Section 250000 – Integrated Automation Systems (IAS) For HVAC
   3. Section 250800 – Fault Detection and Diagnostics Software for HVAC

1.03 SUMMARY

A. Section includes:

   1. Java Application Control Engine (JACE).
   2. Application Specific Controller (ASC).
   3. Advance Application Controller (AAC).

B. The IAS shall be comprised of Niagara 4 JACE Network Controllers added to the existing IAS infrastructure.

C. Provide BTL certified products that communicate on MS/TP channels to meet the functional specifications of this Division and the dedicated product functional specifications and profiles specified in other Sections of this Specification.
D. The number of Niagara 4 JACE network controllers required is dependent on the type and quantity of devices installed. It is the responsibility of the Contractor to determine the quantity and type of devices and to properly install the correct number (increase if required) of network controllers from the designed minimum shown on the IAS documents. The Contractor shall confirm the designed network load and architecture with the capabilities of the selected Network Controller. If network communications issues arise as a result of a limited Network Controller resource count the Contractor shall furnish, install, and implement additional Network Controllers to reduce the network traffic on each Network Controller’s Local Operating Network to less than 50% of maximum network bandwidth or 60% of the available JACE system resource count.

E. Repeaters can be utilized to extend the Device Level Network beyond the 4,000 foot limitation provided neither the device count limitation, 50% bandwidth limitation nor 60% of the available JACE system resource count is exceeded. Repeaters can also be utilized to improve communication within free topology networks.

F. The existing Niagara 4 Supervisor Server shall provide global supervisory control functions over the JACE controllers. The JACE controllers shall provide global supervisory control functions over the control devices that are connected to each network controller. The JACE controller execute application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing (locally and to Web Server)
5. Time synchronization
6. Integration of BACnet®IP (client), BACnet® MSTP, Siemens P1 and P2, Modbus®, OPC controller data, and others as required.
7. Connectivity for Network Management and programming functions for all BACnet and Siemens Apogee based devices.
8. Energy management functions
9. Control functions

1.04 SUBMITTALS

A. General: Submit under provisions of Division 01. Provide a complete and comprehensive submittal package. Partial submittals shall not be accepted. Upon completion submit all compliance data and project record documents.

B. Preconstruction Submittals.

1. Network Controller Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, and finishes for materials for each type of controller indicated. Submit documentation indicating BTL compliance and include Protocol Implementation Conformance (PIC) Statements. Submit Niagara4 Compatibility Statements (NiCS) for each submitted
   a. Niagara 4 JACE Network Controllers
   b. Niagara 4 JACE Network Expansion Modules
c. Niagara 4 JACE Input/Output Point Modules

d. BACnet Building Controllers (B-BC’s)

e. BACnet Application Specific Controllers (B-ASC’s)

f. BACnet Advanced Application Controllers (B-AAC’s)

g. Interface Panels

h. Network Management Equipment (Routers, Protocol Analyzers, etc.)

2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   a. Sheets shall be consecutively numbered. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.

   b. Table of Contents listing sheet titles and sheet numbers.

   c. Legend and list of abbreviations

   d. Controller Panel Diagrams: Provide a panel schematic for each Building Network Controller that depicts the layout of the components within the panel. Include a Bill of Materials listing all of the components installed in the panel. In addition, the schematic shall identify the following pieces of information:

      1). Naming, Location and Addressing information of the Building Network

      2). Controller, including the following:

         i. Computer Name

         ii. Object Name

         iii. Location of the Building Network Controller Panel including room numbers or any other points of reference that may be useful in identifying the location of the controller.

         iv. IP Address

      3). The source of 120VAC power, including the electrical panel name and circuit number.

      4). The type of media and any interstitial devices used for connection of the Building Network Controller to the MCCCD Ethernet Network.

   e. DDC System Architecture: Provide a schematic showing the architecture of the DDC system’s entire Building-Level Network that identifies all Building Network Controllers, Tridium JACE panels, integrated Digital Controllers, integrated Equipment Control Devices (such as VFDs, factory chiller control panels, etc.), repeaters, Operator Workstations (if required by contract documents), and LAN device including fiber optic media, converters, DSL modems, routers, hubs, bridges, and switches. Each Digital Controller, Equipment Controller, and Building Network Controller shall be identified on the schematic using the object name associated with the controller as it appears in the database. Indicate the communication protocol and physical media to be used at each level.
f. Schematic flow diagrams showing the systems for fans, pumps, coils, dampers, valves, and control devices. Indicate the existing point names on the schematic diagrams.


h. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

i. A floor plan indicating the actual location of room temperature sensors, carbon dioxide sensors, and occupancy sensors for coordination with furniture layout.

j. A floor plan indicating location of concealed duct static pressure sensors used for controlling air moving equipment.

k. Written description of sequence of operation. Provide all applicable data related to optimization of energy efficiency. The Engineer of Record’s sequence of operations shall be incorporated into the Shop Drawing sequences. At a minimum, include all software objects, setpoint limits, alarm conditions, alarm priorities, and time delays.

l. Schedule of VAV/CAV boxes identifying the name and number of all rooms served by the box, system name of the controller, associated air handling unit name, minimum airflow setpoint, and maximum airflow setpoint.

3. Test Plan for Contractor Field Tests

a. For every Network Building Controller and Digital Controller provide a Field Test Checkout Sheet. All data that can be filled out on each checkout sheet prior to conducting the test, shall be provided on each sheet.

b. Include the intended test procedure, the expected response, and the pass/fail criteria for every component tested.

C. Construction Submittals

1. Field Test Results: Provide documented results of the testing. The report shall include written responses and documentation of actions made to correct the deficiencies identified in the Field Test Punch List. The contents of the report shall incorporate any changes, modifications, or revisions made to the IAS system and the documentation associated with it, and shall reflect the “as-built” condition of the system.

2. JACE Station Resource Report: After approval of the functional performance testing, the contractor shall submit a report indicating the following performance metrics of each JACE network controller installed or modified by the project. These metrics shall be taken during a heavily loaded network time between 10am and 3pm on a normally occupied weekday.

a. Station Resource Count, including resource counts associated with each child object.

b. CPU Utilization: provide a report of the average idle time of the JACE network controller. If the average idle time is less than 70%, adjust network tuning policies such as cycle times, execution frequencies, and polling frequencies to bring idle times above 70%.

c. Available Flash Space for each NFSG

D. Closeout Submittals
1. As-Built DDC Shop Drawings:
   a. Provide a complete laminated set of as-built DDC drawings that shall be permanently affixed in the Building Network Controller panel. In addition, each Digital Controller panel shall include copies of the laminated as-built DDC drawings that pertain to that system (including the Control System Schematics, Digital Controller Wiring Diagrams, Table of I/O Points, Component Wiring Diagrams, and if applicable the Valve Schedule). All drawings in a panel should be bound together and hung within the panel in a manner that prohibits their removal.
   b. Provide record copies of product data and control Shop Drawings updated to reflect the final installed condition.
   c. Provide as-built network architecture. Drawings showing all nodes including a description field with specific controller identification, description and location information.
   d. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, logical address and drawing reference number.
   e. Provide record riser diagram showing the location of all controllers.
   f. Maintain Project record documents throughout the Warranty Period and submit final documents at the end of the Warranty Period.

1.05 REFERENCED STANDARDS
   A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
   B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
   C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

1.06 QUALITY ASSURANCE
   A. Utilize the Niagara 4 Framework®
   B. All DDC controllers shall conform to the Interoperability requirements outlined in the BACnet® Testing Laboratory Guidelines. All BACnet® products shall be BTL certified prior to delivery of submittals to the Owner for review.
   C. Utilize standard PC components for all assemblies. Custom hardware, operating system, and utility software are not acceptable.

PART 2 - PRODUCTS

2.01 GENERAL
   A. All materials shall meet or exceed all applicable referenced standards, Federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
2.02 STAND-ALONE FUNCTIONALITY

A. The Contractor shall furnish and install single controllers with the physical and software resource count for standalone operation of each piece of equipment. The sequence of operation and required points for control shall reside on a single controller. Remote I/O modules (via a field wired communications bus) are not acceptable for points required to achieve the sequence of operation. Expansion I/O modules plugged directly into the controller may be utilized for expansion.

B. Remote I/O modules shall be permitted for monitoring points and data acquisition. They are only permitted for points which do not affect the sequence of operation and require no logic or actions as a result of a change in value.

C. Where a manufacturer does not have a single controller with a large enough physical point or software point count and direct connected I/O expansion modules will not meet the requirement, the following must take place at the Contractor’s discretion.

1. A second controller or I/O module may be used by establishing a secondary Sub LAN off the primary master controller housing all programming pertaining to the sequence of operation. The sub LAN could be a feature of the controller or created by means of a Router. The operation of the I/O or slave controller must not be affected by the loss of communications of the main bus.

2. The SI Contractor has the option to provide a comparable BTL controller from another manufacturer / vendor, which can meet the resource requirements of the equipment.

D. The following configurations are considered unacceptable with reference to a controller’s standalone functionality:

1. I/O point expansion devices connected to the main controller board via communication wiring that could be interrupted if the primary communication network is compromised (broken or shorted).

2. Multiple controllers enclosed in the same control panel connected via communication wiring to accomplish the point requirement.

2.03 JACE NETWORK CONTROLLERS (NC)

A. The Niagara 4 JACE 8000 network controller must provide the following hardware features as a minimum:

1. TI AM3352 @ 1GHz
2. 1GB RAM
3. 4GB flash total storage / 2GB user storage
4. Embedded Wi-Fi (Client or WAP)
5. High-speed field bus expansion
6. (2) Isolated RS 485
7. (2) 10/100MB Ethernet ports
8. The network controller must be capable of operation over a temperature range of -20°C to 60°C.
B. General Requirements: The Network Controllers shall be Tridium Niagara 4 JACE-8000 controllers. The contractor shall develop the system to accomplish the following as part of this project.

1. The JACEs shall provide fully distributed control independent of the operational status of the OWSs and Niagara 4 Supervisor Server. All necessary calculations required to achieve supervisory control shall be executed within the NC independent of any other device. All control strategies performed by the JACE's shall be both operator definable and modifiable through the Operator Interfaces.

2. The total device count allowed on each Niagara JACE 8000 series network controller is as follows:
   a. Niagara N4 8005 Level Device: Do Not Use
   b. Niagara N4 8010 Level Device: 8 Devices
   c. Niagara N4 8025 Level Device: 20 Devices
   d. Niagara N4 8100 Level Device: 62 Devices
   e. Niagara N4 8200 Level Device: 62 Devices
   f. In addition to BACnet BTL listed controllers, all integrated controllers and equipment shall count as devices towards the capacity limits above. These include devices such as smart meters, communicating HVAC devices, and other integrated equipment.

3. The JACE shall utilize I/O Expansion Modules (IO-16, 10-34, IO-16-485) for direct control of equipment.

4. The JACEs shall utilize the Niagara 4 Framework for discovery, installation, setup, configuration and commissioning of user defined BACnet and non-BACnet devices.

5. JACEs shall perform overall system coordination, accept control programs, perform automated global HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions.

6. JACEs shall share information with the entire network of JACEs (FAC LAN) for full global control directly without requiring other JACEs, LAN devices, Local Supervisory LAN gateways, routers etc. to assist, perform, or act as an intermediate device for communicating.

7. The JACE controller shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

8. Event Alarm Notification and Actions
   a. The JACE controller shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
   b. The JACE controller shall route any alarm condition to any defined user location whether connected to a local, remote or wide-area network.
   c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
      i. To alarm
ii. Return to normal

iii. To fault

d. Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and or classes of alarms, i.e., security, HVAC, fire, etc.

e. Provide routing of alarms by class, object, group, or node and time.

f. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

g. Escalation of unacknowledged alarms to other recipients for up to three levels.

9. Control equipment and network failures shall be treated as alarms and annunciated.

10. Alarms shall be annunciated in any of the following manners as defined by the user:

a. Screen message text

b. Graphic with flashing alarm object(s).

c. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

   i. Day of week

   ii. Time of day

   iii. Recipient

d. Mobile devices using SMS.

e. Printed message, routed directly to a dedicated alarm printer.

11. The following shall be recorded by the NC for each alarm (at a minimum).

a. Time and date

b. Location (building, floor, zone, office number, etc.)

c. Equipment (air handler #, VAV #, etc.)

d. Acknowledge time, date, and user who issued acknowledgement

e. Number of occurrences since last acknowledgement

f. User defined notation

12. Alarm actions may be initiated by user defined programmable objects created for that purpose.

a. Required alarms shall be generated within the network controller. Alarms may be based on information from various sources, including information from ASCs, Control Units, AACs, and other integrated devices and systems. Information will be processed in the network controller, and alarms generated accordingly.

b. When required alarms are not available directly from the control devices, information obtained from the devices can be tested against alarm thresholds and set-points within the network controller, and alarms generated accordingly.
c. Alarm points created in the network controllers shall have set-points which are adjustable from appropriate browser based workstations by users with sufficient password levels.

d. Users with sufficient password levels shall be authorized to acknowledge alarms, enter notes, etc., individually from the browser based operator workstations.

e. Alarms generated by the JACE controllers shall be presented to appropriate workstations in a manner consistent with the presentation of other alarms.

13. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

14. A log of all alarms shall be maintained by the JACE controller and a server (if configured in the system) and shall be available for review by the user.

15. Provide a “query” feature to allow review of specific alarms by user defined parameters.

16. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

17. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

18. Data Collection and Storage:
   a. The JACE controller shall collect data for any property of any object and store this data for future use.
   
   b. The data collection shall be performed by log objects, resident in the JACE controller that shall have, at a minimum, the following configurable properties:
      i. Designating the log as interval or deviation.
      ii. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
      iii. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
      iv. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
      v. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
   c. All log data shall be stored in a relational database in the network controller and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
   d. All log data, when accessed from a server, shall be manipulated using standard SQL statements.
   e. All log data shall be available to the user in the following data formats:
      i. HTML
      ii. XML
iii. Plain text

iv. Comma or tab separated values

f. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

g. The JACE controller shall archive its log data either locally (to itself), or remotely to a server or other network controller on the network. Configure the following archiving properties, at a minimum:

i. Archive each JACE to the Niagara 4 server daily at a specified time of day. Stagger JACE archive times to reduce network traffic.

ii. Provide ability to clear logs once archived

19. Audit Log

a. Provide and maintain an Audit Log that tracks all activities performed on the network controller. Archive log based on time or when the log has reached its user-defined buffer size. Archive locally and to the Niagara 4 server. For each log entry, provide the following data:

i. Time and date

ii. User ID

iii. Change or activity (change set point, add or delete objects, commands, etc.)

20. Database Backup and Storage

a. The network controller shall automatically back up its database. The database shall be backed up based on a user-defined time interval. Request the District time interval at the beginning of the project.

b. Copies of the current database and, at the most recently saved database shall be stored in the network controller. The age of the most recently saved database is dependent on the user-defined database save interval.

c. The JACE controller’s database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

d. Provisioning - Automatic downloading of software updates, backups to the entire system database etc. based on user defined parameters.

21. Network History Policies

a. JACE network controllers shall be configured to store trend data for the previous 48 hours before overriding. Trend data for the previous 24 hours shall be exported to the Niagara 4 server daily for archival. History exports from each JACE shall be staggered in 10 minute intervals to reduce network traffic.

22. JACE Controller and Server Licensing Requirements
a. All New and Existing JACE Controllers and Server equipment and software furnished by or integrated with this project shall be fully licensed to the Owner. The licensing rights shall include the rights for the Owner to authorize any Contractor of their choosing to perform work on the IAS system. The installing contractor shall hold no exclusive rights to the system as it pertains to software, hardware, system updates, system access, modifications, developed databases, etc.

b. Provide the Owner all required user names and passwords for system access yielding full administration and configuration rights. These shall apply to workstations, servers, network controllers, configurable network electronics, controllers, system software/database and the like.

c. The Contractor shall not limit in any fashion the ability for other contractors, vendors or operators the ability to manage, configure, or modify the parameters of each Network Controller, server or system software/database.

d. The Contractor shall coordinate and hold no exclusive rights pertaining to interstation links between Network Controllers.

e. The owner shall have rights to update and modify site specific graphics, application programs and database files associated with the sequence of operation.

f. The owner shall reserve the right and possess the ability to hire a contractor to service, maintain and modify the system. The ability to program, configure, and perform database modifications associated with all the DDC controllers shall likewise be the property of the Owner. The Contractor shall hold no exclusive rights, or access levels to the system. Third party Contractors shall have full rights and access to the system at any point for system expansion or existing system modifications. All configurations shall be performed via Niagara 4 Supervisor®.

g. Upon substantial completion the Contractor shall deliver as part of the O&M manuals to the owner electronic copies containing the current databases, Systems Usernames, Passwords and Access Levels for the following components:

1) JACE Controllers

2) DDC Controllers

2.04 REMOTE/EXPANSION I/O

A. JACEs shall provide the ability to directly control equipment through remote or expansion I/O modules.

B. Remote I/O modules shall provide 8 universal inputs, 4 relay outputs and 4 analog outputs (T-I/O-16-485)

1. Extend control up to 4000 feet from the NC
2. Power: 12-15 Vdc
3. UL 916, CE listed, RoHS compliant
4. Industry standard RS-485 multi-drop communication bus
5. Up to 16 J-T-I/O-16-485 devices can be connected to a single JACE providing a total of 256 I/O points
   a. 16 max per JACE-6E or JACE-7 series controller
6. Environment
a. Operating temperature range: 0°C to 50°C (32°F to 122°F)
b. Storage Temperature range: 0°C to 60°C (32°F to 158°F)
c. Relative humidity range: 5% to 95%, non-condensing

7. Universal Inputs shall be:
   a. Type III 10K ohm Thermistors
   b. Resistance 0-100 K ohms
   c. 0-10 Vdc
   d. 0-20 mA with the use of a 499 ohm resistor

8. Relay Outputs shall be:
   a. Form A contacts, 24 Vac @ 0.5 Amp

9. Analog Outputs shall be:
   a. 0-10 Vdc

C. Expansion I/O modules shall provide 8 universal inputs, 4 analog outputs and 4 digital outputs (IO-16) or 16 universal inputs, 8 analog outputs and 10 digital outputs (IO-34).

1. Environment
   a. Operating temperature range: 0°C to 50°C (32°F to 122°F)
   b. Storage Temperature range: 0°C to 60°C (32°F to 158°F)
   c. Relative humidity range: 5% to 95%, non-condensing

2. Power: 24 Vac/dc

3. Universal Inputs shall be:
   a. Type III 10K ohm Thermistors
   b. Resistance 0-100 K ohms
   c. 0-10 Vdc
   d. 0-20 mA with the use of a 499 ohm resistor
   e. Binary Inputs minimum dwell time > 500 ms (Pulse counter range 20 Hz, 50% duty cycle)

4. Analog Outputs shall be:
   a. 0-10 Vdc each
   b. AO can supply at least 4mA over the entire 0-10 Vdc range

5. Digital Outputs shall be:
   a. Capable of switching loads up to .5A, 24 VAC
b. Each output includes a MOV (metal oxide varistor) suppressor to support inductive type loads

2.05 APPLICATION SPECIFIC CONTROLLER (ASC)

A. Each terminal unit shall have a BACnet® based DDC Application Specific Controller (ASC) designed to provide the specified sequences. The controller shall be BTL certified, shall store all specific control sequences and program settings in non-volatile memory.

B. All ASC processors shall be operating at 5 MHz or higher with 8K of RAM and 64K of Flash memory with minimum 10 year memory retention between program downloads.

C. Each ASC shall perform all intended control functions in a ‘standalone’ mode should the unit incur a loss of communications.

D. The complete ASC including accessory devices such as relays, transducers, power supplies, etc., shall be factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.

E. Each ASC shall communicate using BACnet MS/TP serial communications. Integrated HVAC equipment may communicate over BACnet IP protocol if MS/TP is not available from the manufacturer. All ASCs shall be provided as self-sufficient units to maximize reliability and shall include internal ‘soft’ clock, operating systems, communication timing and interrupt controls, and shall be suitable for the specified applications.

G. In the event of a power outage or controller reset, each ASC shall enter a preprogrammed state on power re-application. Upon application of power to the ASC, all control conditions will start from an ‘off’ / ‘closed’ position or the default state. This state will be maintained for an automatically adjusted amount of time. Once this time delay has passed, the ASC control sequence shall resume according to current values.

H. Network and controller-to-controller communications must conform to BACnet® standards.

I. All ASCs shall be provided with a communications port to allow connection of any industry standard laptop PC and custom configuration tools. Program access via this communications port allows direct field modification of the configuration parameters.

J. Digital Inputs
   1. All digital inputs shall be over voltage protected
   2. Digital Input types supported by the ASC:
      a. Normally open contacts (24V and 120V)
      b. Normally closed contacts (24V and 120V)
      c. Current/no current
      d. Voltage/no voltage
      e. Pulse/Totalizer contacts

K. Digital Outputs
   1. All digital outputs shall be 24 volt AC, current sinking, 0.5 amp opto-isolated triacs.
   2. Digital outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits. It shall be possible to configure outputs for 3-mode control (fast-slow-off) and 2-mode control.
L. Analog Inputs
   1. All analog inputs shall be over voltage protected
   2. The analog to digital resolutions shall be a minimum of 10 bit
   3. Analog inputs shall accept the following temperature types: 10K Ohm thermistor, 20K Ohm thermistor, or 1K Ohm RTD
   4. Inputs shall be configurable to accept a wide range of inputs including: 4-20mA, 1-5Vdc, 2-10Vdc, etc

M. Analog Outputs
   1. The ASC shall accommodate true analog outputs. Voltage (0-10V) and current (4-20 mA) outputs shall be accommodated.
   2. All analog outputs shall be proportional current or voltage type.
   3. The digital to analog resolution shall be a minimum of 10 bit.
   4. Outputs shall be configurable so that 0-100% output commands can represent any portion of the output voltage/current range.
   5. Outputs shall be reversible so that an increasing output command yields a decreasing electrical signal.

N. In addition to local physical or internal I/O, each ASC shall support distributed or ‘bound’ I/O. This bound I/O can be used to allow the ASC to provide I/O data to another controller on the network or to allow another controller to provide data to the controlling ASC.

O. The following general modes of control shall be incorporated into each ASC. The sequence of operations shown in Section 23 09 93 and/or 25 90 00 and on the IAS Drawings indicate the final control sequence and shall define the various modes of operation:
   1. Occupied shall be a mode designed for normal occupied control of an area during regular business hours. This mode shall have unique heating and cooling setpoints associated with it.
   2. Unoccupied shall be a mode designed for after hours control of an area. This mode shall have unique heating and cooling setpoints associated with it.
   3. Override shall be a mode designed to invoke normal occupied control during after hours of an area. This mode shall use the occupied heating and cooling setpoints.
   4. Standby shall be a mode designed for normal occupied times when the HVAC scheduling software indicates that a classroom or event space will not be in use. This mode shall have unique heating and cooling setpoints associated with it.
   5. Morning Warm-Up on units with an outdoor air economizer shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied setpoints but it will prevent outdoor air from entering the space. The outdoor air will move to its minimum position once the morning warm-up mode is over and the occupied mode is activated.
   6. Morning Warm-Up on VAV units shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied setpoints but it will prevent the VAV box from maintaining a minimum air flow until the morning warm-up mode is over and the occupied mode is activated.
7. VAV box ASCs shall have an integral damper actuator and shall be the manufacturer’s standard VAV box controller.

8. It shall be the responsibility of the Contractor to verify that VAV box controllers will physically fit into the VAV box controls enclosure, and that the controllers can register the expected minimum and maximum flow rates utilizing the flow probe provided by the VAV box manufacturer.

2.06 ADVANCED APPLICATION CONTROLLER (AAC) AND BUILDING CONTROLLER (BC)

A. A BACnet® based DDC Advanced Application Controller (AAC) or Building Controller (BC) shall be provided where required to perform the sequence of operation. The AAC or BC shall be fully configurable and programmable via the GUI web browser. The controller shall store all specific control sequences and program settings in non-volatile memory.

B. All AAC and BC processors shall be operating at 5 MHz or higher with 8K of RAM and 64K of Flash memory with a minimum 10 year memory retention between program downloads.

C. Each AAC and BC shall perform all intended control functions in a ‘standalone’ mode should the unit incur a loss of communications.

D. The complete AAC or BC including accessory devices such as relays, transducers, power supplies, etc., shall be factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.

E. Each AAC or BC shall communicate using BACnet MS/TP serial communications. Integrated HVAC equipment may communicate over BACnet IP protocol if MS/TP is not available from the manufacturer. All AACs and BC’s shall be provided as self sufficient units to maximize reliability and shall include internal ‘soft’ clock, operating systems, communication timing and interrupt controls, and shall be suitable for the specified applications.

G. In the event of a power outage or controller reset, each AAC and BC shall enter a preprogrammed state on power re-application. Upon application of power to the AAC/BC, all control conditions will start from an ‘off’ / ‘closed’ position or the default state. This state will be maintained for an automatically adjusted amount of time. Once this time delay has passed, the AAC/BC control sequence shall resume according to current values.

H. Network and controller-to-controller communications must conform to BACnet® standards.

I. All AACs and BC’s shall be provided with a communications port to allow connection of any industry standard laptop PC and custom configuration tools. Program access via this communications port allows direct field modification of the configuration parameters.

J. Digital Inputs

1. All digital inputs shall be over voltage protected.

2. Digital Input types supported by the AAC:
   a. Normally open contacts (24V and 120V).
   b. Normally closed contacts (24V and 120V).
   c. Current/no current.
   d. Voltage/no voltage.
   e. Pulse/Totalizer contacts.

K. Digital Outputs
1. All digital outputs shall be 24 volt AC, current sinking, 0.5 amp opto-isolated triacs.

2. Digital outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits. It shall be possible to configure outputs for 3-mode control (fast-slow-off) and 2-mode control.

L. Analog Inputs
1. All analog inputs shall be over voltage protected.

2. The analog to digital resolutions shall be a minimum of 10 bit.

3. Analog inputs shall accept the following temperature types: 10K Ohm thermistor, 20K Ohm thermistor, or 1K Ohm RTD.

4. Inputs shall be configurable to accept a wide range of inputs including: 4-20mA, 1-5Vdc, 2-10Vdc, etc.

M. Analog Outputs
1. The AAC or BC shall accommodate true analog outputs. Voltage (0-10V) and current (4-20 mA) outputs shall be accommodated.

2. All analog outputs shall be proportional current or voltage type.

3. The digital to analog resolution shall be a minimum of 10 bit.

4. Outputs shall be configurable so that 0-100% output commands can represent any portion of the output voltage/current range.

5. Outputs shall be reversible so that an increasing output command yields a decreasing electrical signal.

N. In addition to local physical or internal I/O, each AAC and BC shall support distributed or ‘bound’ I/O. This bound I/O can be used to allow the AAC to provide I/O data to another controller on the network or to allow another controller to provide data to the controlling AAC/BC.

O. The following general modes of control shall be incorporated into each AAC and BC. The sequence of operations shown in Section 230993 and/or 259000 and on the IAS Drawings indicate the final control sequence and shall define the various modes of operation:

1. Occupied shall be a mode designed for normal occupied control of an area during regular business hours. This mode shall have unique heating and cooling setpoints associated with it.

2. Unoccupied shall be a mode designed for after hours control of an area. This mode shall have unique heating and cooling setpoints associated with it.

3. Override shall be a mode designed to invoke normal occupied control during after hours of an area. This mode shall use the occupied heating and cooling setpoints.

4. Morning Warm-Up on units with a outdoor air economizer shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied setpoints but it will prevent outdoor air from entering the space. The outdoor air will move to its minimum position once the morning warm-up mode is over and the occupied mode is activated.
2.07 PORTABLE WORKSTATION

A. Provide a portable workstation including all necessary software for programming, commissioning, and troubleshooting field level devices. The portable workstation shall be capable of accessing all device data and configuration files. The Portable workstation shall be labeled with the Controller manufacturer and all installed software's. The portable workstation hardware shall meet the following requirements:

1. Commercial standard with supporting 32- or 64-bit hardware (as limited by the direct-digital control system software) and software enterprise server.
2. Windows 10 Pro and Microsoft Office Suite
3. Minimum 2.8 GHz processor,
4. Minimum 500 GB 7200 rpm SATA hard drive with 16 MB cache
5. Minimum 2GB DDR3 SDRAM (minimum 1333 Mhz) memory
6. 512 MB video card
7. Minimum 16 inch (diagonal) screen
8. 10-100-1000 Base-TX Ethernet NIC with an RJ45 connector or a 100Base-FX Ethernet NIC with an SC/ST connector
9. 56,600 bps modem
10. ASCII RS-232 interface
11. 16 speed high density DVD-RW+/- optical drive.

2.08 CONTROL PANELS

A. Provide control panels with suitable brackets for wall mounting, unless noted otherwise, for each control system. Locate panel adjacent to systems served. Mount center of control panels 60 inches above finished floor or roof.

B. Interior Panels: Fabricate panels of 16-gage furniture-grade steel, totally enclosed on four sides, with removable perforated backplane, removable hinged door and keyed lock, with manufacturer's standard shop-painted finish and color. Control Panel enclosures shall be NEMA 1 rated. Lock shall be keyed identical for all Digital control panels provided for this project.

C. Exterior Panels: Provide 16-gage 304 or 316 stainless steel NEMA 4X enclosures. Panel shall have hinged door, keyed lock, and integral, thermostatically controlled heater. Provide hinged deadfront inside panel when flush-mounted control and/or indicating devices are included in panel. Fiberglass or aluminum, as applicable, to be used when gases that are being used in the panel area are corrosive to stainless steel.

D. Provide UL-listed cabinets for use with line voltage devices.

E. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal block. All wiring from field devices must terminate on Terminal Blocks. Connections made in the panel shop will then interconnect from the Terminal Block to the Controllers.
F. Provide a 6 inch x 6 inch minimum wireway (metal wiring/tubing) trough across the entire width of the panel mounted to the top of the panel with close nipples of sufficient size for additional 50 percent wiring and tubing capacity. Wireways shall not be less than 24 inches in length. Control panel wiring shall be installed and distributed in the wireway to minimize routing of wiring and tubing within the control panel. Wireway construction to be the same as the associated control panel.

G. Each control panel shall have a power transformer with integral disconnect switch and 120V Power outlet as defined on the IAS drawings.

H. All Digital Control panel wire/tubing paths shall be housed in Panduit (open slot wiring duct with cover).

I. Each Control Panel shall have permanently affixed lamacoid label with the following information:
   1. Control Panel number (DCP-1, DCP-2, NCP-X etc.).
   2. Equipment served (Chiller 1, AHU-1, etc.).
   3. Circuit Breaker number feeding panel.
   4. All gauges and control components shall be identified by means of nameplates.

J. Complete wiring and tubing termination drawings shall be mounted in, each panel in a frame with lexan cover of sufficient size to be easily readable.

K. Sheet metals screws shall not penetrate the cabinet walls, door, or back.

PART 3 - EXECUTION

3.01 PREPARATION
A. Examine areas and conditions under which control systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Owner.

B. Beginning of installation means installer accepts existing conditions.

C. Communications wiring is indicated on the contract documents. Examine the site and identify any potential problems or conflicts. Submit recommended modifications and omissions to the Owner’s representative.

3.02 INSTALLATION
A. Installation shall meet or exceed all applicable Federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room.

D. After completion of installation, test and adjust control equipment. Submit data showing setpoints and final adjustments of controls to the District.

E. Mount all I/O and ancillary devices per manufacturer’s installation instructions and in the locations shown on the drawings.
3.03 SYSTEM ACCESS

A. Provide an Ethernet connection and a 5 port hub at each panel housing a JACE Controller or controllers. The user shall be able to access each controller on the system using this connection via the Control System Server database for graphics, schedules, programming, controller configuration etc.

3.04 HARDWARE APPLICATION REQUIREMENTS

A. Standalone Capability:
   1. Each Controller shall be capable of performing the required sequence of operation for the associated equipment.
   2. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated Controller with only the exceptions enumerated below. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other Controllers via the FAC LAN.

B. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

C. Application Category 0 (Distributed Monitoring):
   1. Applications in this category include the following:
      a. Monitoring of variables that are not used in a control loop, sequence logic, or safety.
   2. Points on JACEs, AACs, and ASCs may be used in these applications as well as IASs and/or general-purpose I/O modules.
   3. Where these points are trended, Contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.
   4. Standalone Capability:
      a. Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control.
      b. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any values, the controller shall use the last value obtained before the fault occurred.

END OF SECTION
SECTION 25 15 00
IAS SOFTWARE AND PROGRAMMING TOOLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
C. Related Specifications:
   1. Section 250600 - Network Scheduling Software for HVAC
   2. Section 250800 – Fault Detection and Diagnostics Software for HVAC
   3. Section 250900 – Chiller Plant Optimization Software
   5. Section 251400 – IAS Network Controllers for HVAC
D. Guideline A - IAS Graphics Requirements
E. Guideline B - IAS Point Naming and Tagging Convention

1.02 SUMMARY
A. This section describes the features and requirements of the hardware and software necessary to manage the Integrated Automation System (IAS) Control Networks. Section Includes:
   1. Network Management
   2. Graphical User Interface
   3. System Software
   4. Application Programming Description
   5. Application Control Logic
   6. Application Builder
   7. Energy Management Applications
   8. Graphical User Interface Software
   9. User Management
   10. Point Structuring
   11. Trending
   12. Alarm Reporting
13. Dynamic Color Graphics

B. Fully configure systems and furnish and install all software, programming and dynamic color graphics for a complete and fully functioning system as specified.

C. Provide network management of all IAS control devices.

D. Provide custom set-up and development of the software to provide the functional and performance requirements specified. Develop system graphics for all specified mechanical and electrical systems, using animated objects to display all system variables and process valves. Design package shall include sample screen shot captures or the Graphics Requirements Exhibit to define the presentation, operation and navigation to be provided within the GUI.

E. Provide supervisory control strategies for mechanical and electrical systems to permit the global sequence of operations specified herein.

F. Network Operating Software requirements as outlined in Section 25 00 00 (IAS) Integrated Automation System.

G. Full RAS and WAN support.

H. Provide System Diagnostics to proactively maintain continuous operation of all IAS network devices.

I. Refer to Section 25 00 00 – Integrated Automation System (IAS) General for general requirements as well as requirements for interface with Owner’s WAN.

1.03 SUBMITTALS

A. General: Submit under provisions of Division 01. In addition, an electronic version of the completed materials shall be provided on electronic media. Data can be in native file format or scanned where necessary. Provide a complete and comprehensive submittal package. Partial submittals shall not be accepted. Upon completion submit all compliance data and project record documents.

B. Preconstruction Submittals. Provide within 70 calendar days of contract award.

1. IAS Graphics Submittal: A copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner.

   a. The graphics submittal is due within 90 days of the award of contract.
   b. Include a minimum of 120 additional hours and four Owner meetings to revise graphics based on Owner and design team comments.

2. Detailed point list. Include all hardwired points, integrated points, virtual points, and alarms. Indicate read/write capability of all points. Indicate proposed trending periods and frequencies for all points. Use the following ASHRAE Guideline 13 recommended format:

<table>
<thead>
<tr>
<th>POINT NAME</th>
<th>HARDWARE POINTS</th>
<th>SOFTWARE POINTS</th>
<th>TREND FREQUENCY (MIN)</th>
<th>SHOW ON GRAPHIC (Y/N)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AI</td>
<td>AO</td>
<td>DI</td>
<td>DO</td>
<td>AV</td>
</tr>
</tbody>
</table>

STUDENT SERVICES BUILDING IAS SOFTWARE AND PROGRAMMING TOOLS FOR HVAC
MiraCosta College - Community Learning Center 25 15 00 - 2
MCC Project 04001 | Lord Architecture Project 1707-100 5/28/2019
3. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 25 15 00 and the Graphics Requirements Guideline for additional requirements.

C. Construction Submittals

1. Provide the results of BACnet Protocol Analyzer testing for each BACnet MSTP subnetwork added or modified as part of the project. Run the protocol analyzer software for a minimum 24 hour period and submit the results. Data included shall include data traffic, average measured bandwidth usage, and a summary of discovered BACnet devices.

2. Seventy-Two (72) Hour Trend Data: Upon completion of testing provide a seventy-two (72) hour data indicating complete operation of the IAS System. The Trend Data shall be in the form of color Trend Graphs and associated data in Microsoft Excel format. Submit trends of all points and virtual points for each HVAC system within a single Excel tab. Provide Trend Data graphs for each piece of HVAC equipment or plant to demonstrate compliance with the project sequence of operation. Provide setpoint trends along with measured value trends to compare setpoint to performance. Submit specified list of points and graphic format of trending for approval prior to commencement of 72-hour trending.

D. Closeout Submittals

1. Provide the End User License Agreement (EULA) associated with all MiraCosta software as part of the MiraCosta product submittal package.

2. Control Logic Documentation: Submit control logic program listings (for graphical programming) and logic flow charts illustrating (for line type programs) to document the control software of all control units. Submit functional temperature control diagrams for each mechanical system served by the IAS. Indicate and tag each input/output served by each ASC or AAC and show locations and functions of ISA’s

1.04 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. Refer to Guideline A - IAS Graphics Requirements for additional requirements regarding the District’s licensed graphic theme and toolset for IAS systems.

C. All referenced amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

D. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.
1.05 LICENSING

A. Provide or upgrade all licensing for all software packages at all required Niagara 4 JACE Network Controllers and Supervisors. IAS licensing shall allow unlimited simultaneous users for access to all aspects of the system including system access, workstations, points, programming, database management, network management, graphics etc. All operator interfaces, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner. All Niagara 4 Supervisors shall have NICs set for open communication by all vendors as defined in section 25 00 00.

B. At least two (2) sets of electronic storage media shall be provided with backup software for all software provided, so that the Owner may reinstall any software as necessary. Include all licensing for workstation operating systems, and all required third-party software licenses.

C. In the last month of the Warranty Period, upgrade all software and firmware packages to the latest release (version) in effect at the end of the Warranty Period.

D. Refer to Section 25 00 00 - Integrated Automation System (IAS) General for further requirements.

1.06 NETWORK MANAGEMENT

A. The Contractor shall furnish network management hardware and software to logically manage, configure and program the IAS Control Devices locally. The Contractor shall provide network management of the IAS Control Devices. Network management shall include the following services: Device installation, device configuration, device diagnostics, programming, device maintenance, network variable binding, channel traffic analysis, message priority levels, alarm message routing and repeating and protocol conversion.

B. Network Management Software shall be an intuitive interface for network design and installation and act as a bridge to integrate BACnet and Siemens P1/P2 devices. The Network Management tool shall include all software modules necessary to provide complete network management, configuration, programming and maintenance locally and via the GUI web browser.

1.07 GRAPHICAL USER INTERFACE

A. The Graphical User Interface on the MiraCosta network shall be provided in whole through DGLogik’s DGLux 5 visualization software (aka Atrius IoT Solutions). All MiraCosta Command and Control and functionality shall be provided within the DGLux environment. DGLux is listed a sole-source product in the District’s design and construction standards. Alternate products will not be considered acceptable. Embedded screen interfaces from other thin client applications are not acceptable. Provide the following functionality:

1. The User Interface software shall include support for building automation supervisory control, data acquisition, alarming, historical data collection and trending, and management report generation. The software shall be developed using a Windows based, 32 bit or 64 bit, object oriented programming language. The User Interface software shall have an open architecture design that allows the system to run in a multi-tasking, multi-user environment with support for on-line, dynamic data exchange and the latest version of ODBC with other applications such as spreadsheets, and database programs. The system shall have the built-in flexibility to permit easy configuration of the system in accordance with the specific objectives of the end user, as well as quick and easy modification of the end application by the user in the field.
2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a
tree view (similar to Windows Explorer) for quick viewing of, and access to, the
hierarchical structure of the database. Refer to Guideline A. In addition, menu pull-
downs, and toolbars shall employ buttons, commands and navigation to permit the
operator to perform tasks with a minimum knowledge of the HVAC Control System and
basic computing skills. These shall include, but are not limited to, forward/backward
buttons, home button, and a context sensitive locator line (similar to a URL line), that
displays the location and the selected object identification.

3. Real-Time Graphic Displays. The GUI shall, at a minimum, support the following
graphical features and functions:

   a. Graphic screens shall be developed using any drawing package capable of
generating a GIF, BMP, PDF, or JPG file format. Use of proprietary graphic file
   formats shall not be acceptable.

   b. Graphic screens shall have the capability to contain objects for text, real-time values,
   animation, color spectrum objects, logs, graphs, HTML or XML document links,
   schedule objects, hyperlinks to other URL’s, and links to other graphic screens.

   c. Modifying common application objects, such as schedules, calendars, and set points
   shall be accomplished in a graphical manner. Schedule times will be adjusted using
   a graphical slider, without requiring any keyboard entry from the operator. Holidays
   shall be set by using a graphical calendar, without requiring any keyboard entry from
   the operator.

   d. Commands to start and stop binary objects shall be done by right-clicking the
   selected object and selecting the appropriate command from the pop-up menu. No
   entry of text shall be required.

   e. Adjustments to analog objects, such as set points, shall be done by right-clicking the
   selected object and entering the desired value.

4. System Configuration. At a minimum, the GUI shall permit the operator to perform the
following tasks, with proper password access:

   a. Create, delete or modify control strategies while the Network Controller is online.

   b. Add/delete objects and network variables to the system.

   c. Tune control loops through the adjustment of control loop parameters.

   d. Enable, disable or create control strategies; configure and program controllers.

   e. Generate hard copy records or control strategies on a printer.

   f. Select points to be alarmable and define the alarm state.

   g. Select points to be trended over a period of time and initiate the recording of values
   automatically.

B. Web Browser Interface Description:

   1. The system shall be capable of supporting an unlimited number of clients using a
   standard Web browser (e.g. Chrome™, Internet Explorer™, FireFox™). Systems
   requiring additional software (to enable a standard Web browser) to be resident on the
   client machine, or manufacture-specific browsers shall not be acceptable.
2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the IAS, shall not be acceptable.

3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

4. The Web browser client shall support at a minimum, the following functions:
   a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
   b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
   c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
   d. Storage of the graphical screens shall be in the network web server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
   e. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
   f. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
      i. Modify common application objects, such as schedules, calendars, and set-points in a graphical manner. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
      ii. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
      iii. View logs and charts.
      iv. View and acknowledge alarms.
      v. Set up and execute SQL queries on log and archive information.
   g. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

C. Alarm console

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop. This window will notify the operator of new alarms and un-acknowledged alarms.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, Federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 SYSTEM SOFTWARE-GENERAL

A. Functionality and Completeness: Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.

B. Configuration: The software shall support the system as a distributed processing network configuration and shall utilize Niagara 4 Supervisor for engineering, installation and commissioning.

C. Database: The Niagara Supervisor server software shall be purchased with an SQL license and configured to automatically push all historian trend data to the District’s Microsoft SQL Server database.

2.03 NETWORK MANAGEMENT SOFTWARE

A. General: Utilize Niagara 4 Supervisor

B. Network Management clients shall be capable of performing the following network services by accessing the appropriate network node databases from the Network Services Server:

1. Device / node installation
2. Device / node configuration
3. Device / node diagnostics
4. Device / node maintenance
5. Programming
6. Network variable binding
7. A network variable browser
8. A graphical user interface
9. System diagnostics

C. The Network Management Server Application shall reside on the IAS Local Area Network server. This application shall support multiple thin clients on the Local Area Network via the GUI web browser.

D. Direct Ethernet based driver support for BACnet I/P, OPC (Client), Modbus TCP, LON IP and SNMP.

2.04 CONTROLLER SOFTWARE

A. JAVA APPLICATION CONTROL ENGINE (JACE) CONTROLLER Software Residency: Each JACE as defined below shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the JACE controller:

1. Real-Time Operating System software
2. Real-Time Clock/Calendar and network time synchronization
3. JACE diagnostic software including resource management, memory utilization, scan times, device counts and device status and logging of internal operations
4. Direct Digital Control software including a library of control objects to perform standard BMS functions as specified in the sequence of operation.
5. Energy Management software including a library of objects to perform energy management functions as specified in the sequence of operations.
6. I/O (physical and virtual) database- supporting up to 32 field I/O modules as required for the sequence of operation.

B. Alarm services software to provide:
   a. On call notification services and reporting
   b. Programmable Floating alarm limits
   c. Emailing of alarms including alarm escalation
   d. SMS, line printer, station recipient
   e. Alarm acknowledgement via email, SMS and remote alarm portal
   f. Alarm history acknowledgement with history and user notations.
   g. A minimum of 100 alarm classes

C. Audit History shall store changes made to objects including time stamp, object name, old value, new value and user identification of the user making the modifications.

D. Backup service shall be automatically provided to include the entire JACE controller. The backup service shall have the ability to exclude specific files in the backed up database.

E. Email Service shall create individual incoming and outgoing email accounts, an email alarm acknowledge, and shall specify email recipients as requested by the District during the project configuration.
F. History Service shall provide access to histories of all activity in the JACE. The service shall allow the operator to enable/disable all history collection with a single operation. Tagging of the history files shall allow the user to group and combine histories into a single file.

G. User and Category Service shall support RSA secureID or LDAP or active directory integrations. The user service shall provide for the capability to create unique users with defined expiration intervals, warning periods and password history length. This service shall provide the ability to define object access, navigation to specific objects or graphics, define the user profile. User access shall be capable of being disabled based on time of day.

H. Weather Service shall provide current weather as well as forecast weather conditions by receiving the current and forecasted weather from any NOAA (National Oceanic and Atmospheric Administration) weather servers. Data obtained from this service may be used for optimization routines as required in the JACE.

I. Web Service shall provide unlimited web access service to the JACE. No user seats or licenses shall be required. It shall support HPPT, HTTPs (SSL and/or TLS) Encryption certificates. The service shall allow the user to specify ports other than the default HTTP/HTTPS ports.

J. Platform Services shall provide the ability to perform:
   a. TCP/IP network management
   b. License management
   c. Serial port configuration and management
   d. Certificate management for SSL/ TLS certificates and shall include key store, trust store and key management. The tool shall provide the ability to create certificates and manage certificates from third parties.

K. Field device Network management – all communication drivers (BACnet, Modbus etc) shall utilize a single field device network manager tool that provides a common look and feel without regard to protocol.

L. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions.

M. Network Communications: Each controller shall include software/firmware that supports the networking of controllers on a common communications trunk. Network support shall include the following:

N. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.

O. Operator/System communication software shall facilitate communications between other JACEs, all subordinate AACS/ASCs, Gateways and LAN Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is on-line and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.

P. Network Management: Point/system database creation and modification shall be via a user-friendly, menu-driven program. Network Management software shall support virtual or logic point (points not representing a physical I/O) creation.
Q. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions.

R. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as more fully specified below.

S. Application Programs: Controllers shall support and execute application programs as more fully specified below:

T. All Direct Digital Control software, Energy Management Control software, and functional block application programming software templates shall be provided in a ‘ready-to-use’ state, and shall not require (but shall allow) Owner programming.

U. Line programs shall supply preprogrammed functions to support energy management and functional block application algorithms. All functions shall be provided with printed narratives and/or flow diagrams to document algorithms and how to modify and use them.

V. Security: Controller software shall support multiple level password access restriction.

W. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:

1. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output.
2. Two Position control (Hi or Low crossing with deadband).
4. Delay Timer (delay-on-make, delay-on-break, and interval).
5. Hi/Low Selection.
6. Reset or Scaling Module.
7. Logical Operators (And, Or, Not, Xor).

X. Psychometric Parameters: Controller software shall provide preprogrammed functions to calculated and present psychometric parameters (given temperature and relative humidity) including the following as a minimum: Enthalpy, Wet Bulb Temperature.

Y. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an OWS or CSS connected locally, to the FAC LAN, to the device level network and remotely via the Internet as applicable, but all must be available.

Z. Restart: System software shall provide for orderly shutdown upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained; outputs shall go to programmed fail (open, closed, or last) position. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.

AA. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously. Automatic time synchronization shall be provided.
BB. Miscellaneous Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.

2.05 FIELD LEVEL CONTROLLER SOFTWARE

A. Provide field controllers software for programming, commissioning, or other configuration furnished on a portable laptop workstation. The BAS Contractor shall furnish the Owner with a portable laptop workstation preloaded with all software needed to connect to, communicate with, command, program, and commission field panels and controllers at no additional charge to the Owner.

B. Hardware and software covered under this requirement includes, but is not limited to:
   1. All software tools, configuration tools, management tools, and utilities used during system commissioning and installation.
   2. Communication modules, software keys, and similar hardware needed for communication from a laptop computer or PDA to field panels or controllers.
   3. Proprietary cables required for communication between laptop computers or PDAs to field panels or controllers.
   4. Proprietary software needed to communicate to field panels or controllers such as HVAC Pro, Metasys, Commissioning Tool, etc.
   5. Passwords, access levels and similar software permissions necessary for execution of the Cx Process.
   6. Software and hardware manuals for all control system hardware and software provided to the owner.

2.06 APPLICATION PROGRAMMING DESCRIPTION

A. The application software shall be user programmable.

B. This Specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. General approaches to application programming shall be provided by one, or a combination, of the following conventions:

C. Point Definition: Utilize Niagara 4 Supervisor to support input of individual point information.

D. Graphical Block Programming: Manipulation of graphic icon ‘blocks’, each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.

E. Functional Application Programming: Pre-programmed application specific programs that allow/require limited customization via ‘fill-in-the-blanks’ edit fields. Typical values would be setpoints, gains, associated point names, alarm limits, etc.

F. Line Programming: Textual syntax-based programming in a language similar to BASIC designed specifically for HVAC control. Subroutines or functions for energy management applications, setpoints, and adjustable parameters shall be customizable, but shall be provided preprogrammed and documented.

G. Provide a means for testing and/or debugging the control programs both off-line and on-line.
2.07 APPLICATION CONTROL LOGIC

A. The following type of process variable types shall be supported:
   1. Discrete: On/Off or 0/1
   2. Integer: 32 bit signed integer value between -2,147,483,648 and +2,147,483,647
   3. Real: +/- 3.4 E38
   4. String: Text string up to 131 characters long

B. System shall have the ability to execute user defined logic scripts. Logic scripts shall be created in an object or statement based programming environment. No compilers or linkers shall be required.

C. System logic shall be able to automatically perform functions such as increase set-points, perform totalization, and check the status of process set-points to take action.

D. System logic shall be able to control and start other application programs running in the multi-tasking environment.

E. System logic shall be able to monitor the status of each process variable in the system, and perform specific functions based on the following parameters:

   Normal Status                Alarm Status
   LoLo Alarm Status             Lo Alarm Status
   Hi Alarm Status               HiHi Alarm Status
   Logical Result of Boolean Expression Individual Bit in Word Status (0-31)
   Acknowledged Alarm Status    Unacknowledged Alarm Status

F. System shall have the capability to perform application control to turn on/off discrete points, show windows, download recipes, etc. This application logic shall also start and stop other application programs in the multitasking environment, including spreadsheet programs, database programs, and recipe storage programs. Condition Logic shall be able to support up to 32,767 bytes of memory and shall support the following command functions:
   1. String Functions
   2. Math Functions
   3. System Functions
   4. Add-On Functions
   5. Miscellaneous Functions

G. System shall have the capability to perform application control based upon a user definable state of a process variable or the result of an expression involving multiple process variables. This includes discrete variable on or off state, alarm states such as HiHi or LoLo, or equivalence to a specific value.

H. System shall have the ability to execute System Logic when the value of a Process Variable changes.
2.08 APPLICATION BUILDER CAPABILITIES

A. Graphics development tools shall allow the creation of filled rectangles, circles/ellipses, polygons, and arcs. All display elements such as real time and historical trends, alarm summary displays, bitmap images, and charts shall be configurable objects with the capability to be placed in any window in any configuration.

B. The graphic drawing system shall be object-oriented.

C. The system shall support the import of .DXF files with the drawing elements imported as native objects. It shall be possible to animate these objects using the full set of object animation properties.

D. Graphics editor shall also allow the user to import drawings and images in .BMP file format.

E. In order to ensure the most productive graphics development environment, animated graphic objects or symbols shall be copyable in just two keystrokes, and immediate substitution of a tag name for the duplicated object shall be possible without leaving the graphics editor.

F. Animated graphic objects or process symbols shall be copyable from one window or display to another with all of their animation characteristics retained, thereby eliminating duplication of effort. In addition, it shall be possible to import windows from another application in this same fashion.

G. User shall have the capability to add tag name dictionary items while building a display without exiting the graphics editor.

H. User shall have the capability to search for process tag names while building a display and then get the exact detail of the item (alarm set-points, I/O address, and all other dictionary details) while building a display without exiting the graphics editor.

I. User shall have online context sensitive help on the display build routines to be able to obtain immediate help should he or she have a question about the details of linking objects to the tag name database dictionary.

J. The user shall be able to configure graphic screens while the system is monitoring the process.

K. User shall have the capability to edit tag name items and add new tag names while the system is running the process.

L. It shall be possible to export the entire database in .CSV format for import and subsequent editing to a spreadsheet such as Excel.

M. It shall be possible to import the entire database from a .CSV file created with Excel.

N. A built-in editor shall be provided for the development of logic scripts. The editor shall be a full-featured text editor with single keystroke entry of Tag names, logic constructs and script functions. When a script function is placed in the editing window any arguments necessary for the script function to operate shall be automatically pasted into the window.

O. Online help shall be provided for all script functions.

P. The user shall be able to configure and edit logic scripts while the system is monitoring the process.

2.09 REPORT WRITER

A. Report Printing Capability
B. Printed reports shall contain process information including process data, status, accumulated variables, etc.

C. Reports shall have the capability to include a snapshot of trends, histograms, and SPC charts on the printed report.

D. Reports shall support use of graphic templates in a printed report.

E. Report Scheduling

F. Reports shall be able to be scheduled by time of day, day of week, hour of day, or at the end of a shift.

G. Reports shall be able to be printed on demand by the operator.

H. Reports shall be able to be printed based on any state change in the system.

2.10 ENERGY MANAGEMENT APPLICATIONS

A. System shall have the ability to perform all of the following energy management routines via preprogrammed function blocks or template programs. As a minimum provide the following whether or not required in the software:

1. Meets ANSI C12.20 Accuracy Standard
2. Time-of-Day Scheduling
3. Calendar-Based Scheduling
4. Holiday Scheduling
5. Temporary Schedule Overrides
6. Optimal Start/Optimal Stop-based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
7. Night Setback and Morning Recovery Control, with ventilation only during occupancy
8. Economizer Control (enthalpy set-up for heating and cooling)
9. Peak Demand Limiting / Load Shedding
10. Dead Band Control

B. The User Interface HVAC application package shall automatically perform predefined calculations based on operated input, real-time data and required constants. Calculations shall be defined for evaluation by both the User Interface and IAS LAN Clients. Calculations shall include, but not be limited to, the following

1. Enthalpy: Calculate total heat of air by sensing dry bulb and either relative humidity, wet bulb, or dew point
2. Relative Humidity: Calculate RH from dry bulb temperature and either wet bulb or dew point. Acronym and type of sensor shall be operator input.
3. Liquid Flow: Calculate flow rate from differential pressure across an orifice or venturi, or from an annubar sensor. Sensor acronym and type shall be operator input.
4. Zone Heat Energy: Calculate total heat energy in a zone based on dry bulb and either wet bulb, relative humidity, or dew point, and the volume of the space. All parameters shall be operator input.

5. Electrical Power: Calculate electrical power based on voltage and amperage, or on pulse meter input.

6. Fluid Btu Rate: Based on flow and differential temperature.

7. Addition/Subtraction/Multiplication/Division/ - Min/Max/Increment/ Decrement: Add, subtract, multiply, divide, selection of min or max for a number of real values and/or constants, and increase or decrease value by a fixed amount to obtain a virtual value.

8. Steam Flow: Calculate steam flow from pressure and temperature values.


10. General Degree Three Polynomial.

11. Degree Days.

C. Calculated points for which all component data is available within the realm of a single Control Unit shall be downloaded to the Network Controller or IAS LAN Server for calculation. Changes of state shall be reported to the IAS LAN Server as described for analog points. The definition of such a point shall include the creation of a free form algorithm using a command language designed specifically for User Interface applications. In addition to the arithmetic operators listed above, the algorithm shall allow trigonometric, logarithmic, and exponential terms. The time increment of calculating such points shall be on a resolution of 10 seconds.

D. Calculations requiring data from more than one controller shall be defined for evaluation by the User Interface Workstation. The operator shall choose the output units for the calculations from a list. The operator shall be able to determine the time increment for performing calculations on a resolution of 1 minute. Each calculated point shall be assigned a calculation priority which dictates the order in which the calculations are performed. Acronyms of sensed values shall be input by the operator. The operator shall input the value of required constants.

E. Calculated points shall be defined through the operator’s terminal in the same manner as sensed points with additional information requested as required. The calculated point shall appear to the operator as any real point (with a sensor) and the operator shall be able to use the acronym of the calculated point in the same manner as a real point.

F. Run-time Totalizing: Provide the capability to totalize the number of hours that any binary point in the system is in the “on” condition. The point may be a motor, lights, unlocked doors, and so forth. Every binary point shall be able to be totalized on operator assignment.

1. The operator shall be able to set limits associated with run-time. Provide capability to have a limit with every binary point. Limits shall be set through the operator’s keyboard. The system shall print an alarm on the event printer when the run-time of a point reaches the run-time limit. Run-time totals and limits shall be able to be reset from the operator’s terminal on command.

2. The operator shall be able to list a summary of run-time totals and each associated limit, if any. The summary shall be of all binary points or restricted to a particular location, system or point. The summary shall also be able to be restricted to those points that have reached the run-time limit.
G. Analog Totalizing/Averaging: Any analog or calculated point in the system shall be able to be assigned to the totalized and/or averaging program. The points assigned shall be totalized for averaged as minimum of once a minute. The following totals and averages for each point assigned shall be kept in storage.

1. Last 12 Months, by Month
2. Last 30 Days, by Day
3. Last 24 Hours, by Hour
4. Last Hour, by 5 Minute Increments
5. Last 10 Minutes, by Minute

H. Time Based Control

Any commandable point in the system shall be able to be assigned a specific command by time of day and day(s) of week through the operator’s terminal. The number of commands per point, per day, shall be limited only by the amount of memory available in the respective controller.

1. The following commands shall be available:
   a. Start
   b. Stop
   c. Auto
   d. Low
   e. High
   f. Change set-point
   g. Change high limit
   h. Change low limit

2. Points shall be assigned time windows in which the assigned command is valid. Points shall be able to be assigned different time windows each day of the week plus a holiday schedule. Provide a means of deleting points from the time schedule by day(s) and time window.

3. Provide a time delay between starts, within an individual controller, that shall be adjustable on a per point basis.

4. Time schedules shall be downloaded to the respective controller for implementation. Loss of communication with the User Interface Workstation shall not affect the operation of downloaded time schedules. Any changes made by a time schedule shall be communicated to the User Interface Workstation and saved to the IAS LAN Server.

5. The operator shall be able to list summaries of time schedules on the operator’s terminal or data logger. The summary shall indicate the point and the various time windows assigned for that particular day. The summary shall be able to be restricted to a particular location, system, system type, point type, or point as well as to those days of the week desired.
6. Provide a means of scheduling holidays one year in advance. The system shall recognize scheduled holidays and run the holiday schedule for that day or days. The holidays shall be defined through the User Interface Workstation.

7. Provide a means to extend the time of equipment operation in a particular zone. The extended time shall be initiated from an operator’s keyboard or for a binary input request from the one itself. The extension shall be for a user defined period (minutes, days) and the system shall automatically use the normal schedule the next day. The zone, equipment within the zone (motors, lights, and so forth), and the length of the time extension shall be defined through the User Interface Workstation. Provide a summary of zone parameters and a summary of zones currently operating under extended time.

I. Time and Event Programs: Provide a method for automatically running programs based on occurrence of specified changes in the status of any binary, analog, or calculated point.

1. The following changes in status shall be able to generate an automatic sequence.
   a. Change of binary status from 1 to 0, or 0 to 1
   b. Reaching run-time limit
   c. High analog alarm (adjustable, prioritized)
   d. Low analog alarm (adjustable, prioritized)
   e. Analog return to normal

2. Each input point in the system shall be able to initiate a program and any number of points shall be able to initiate the same program

3. Points initiating programs shall pass a number of parameters to the program. These parameters shall be the following:
   a. Acronym of the point
   b. Pointer to the point in the data base
   c. Current status
   d. Last value

4. Programs shall be assigned to points through the User Interface Workstation. Assignments shall be able to be modified at any time. Time and Event Programs shall be generated at the User Interface Workstation and downloaded to local NC for execution.

5. The operator shall be able to request a summary of all automatic sequences with point assignments. The summary shall be displayed or printed on the data logger.

J. Duty Cycle: The operator shall be able to assign through the operator’s terminal online any controlled load in the system on the duty cycle program and define associated parameters. Parameters shall be individually assigned per load.

1. Parameters shall be at least as follows:
   a. Acronym of the load start/stop point
   b. Acronym of the point that will feed back, (space temperature, loop temperature, differential pressure, other)
c. The minimum on and off times for the load required for equipment protection from damage

d. A description of at least one complete cycle and the time windows in which each is to be followed. At least five different cycles shall be allowed in any one day. The system shall support unique schedules for each day of the week (including holidays) and schedules do not violate the equipment’s minimum on and minimum off times. Cycles shall be defined with a resolution of at least five minutes.

2. The operator shall be able to modify any parameter on an individual basis at any time

3. Each load assigned to the duty cycler shall be cycled based on the individual parameters assigned to it. The duty cycler shall not stop the load if the feedback (space temperature, loop temperature, differential pressure, other) is in alarm. In no case shall the load ever be on or off for less time that the minimum on or off times defined.

4. The operator shall be able to display or print all the parameters associated with a load assigned to the duty cycler on request. Summaries shall be able to be requested for all points or restricted to a particular location or load by operator choice.

5. Loads shall be able to be locked out from or restored to the duty cycler by the operator at any time

6. Duty cycling shall be performed by a controller using parameters downloaded from the IAS User Interface Workstation. A change of state shall be reported to the IAS User Interface Workstation Server by the controller each item the duty cycler starts or stops the load.

K. Power Demand Monitoring and Load Shedding: The operator shall be able to assign through the operator's terminal online any controlled load in the system to the load shed program and define associated parameters. Parameters shall be individually assigned per load.

1. Parameters shall be at least as follows:

   a. Acronym of the load start/stop point

   b. Acronym of the point that will feed back space conditions or system status to the program [i.e., space temperature, differential pressure, light level (foot-candles), etc.]. If no space temperature point exists, this parameter shall not have to be defined.

   c. The minimum on and off times for the load required for equipment protection from damage.

   d. The kilowatt rating of the load.

   e. The acronym of the electric meter that the load is associated with.

   f. The priority level of the load. Provided capability of 16 priority levels.

2. The operator shall be able to modify any load parameter on an individual basis at any time.

3. The operator shall be able to display or print all of the parameters associated with the load assigned to the load shedding program on request. Summaries shall be able to be requested for all points, or restricted to a particular location or load by operator choice.

4. Demand meters shall be defined by the operator through the operator's terminal. Parameters associated with demand meters are as follows:
a. Acronym of the meter

b. The demand limit to begin shedding loads

c. The demand at which loads shall begin to be restored

d. The number of priority level associated with the meter

e. The demand interval strength

5. The operator shall be able to modify any meter parameters on an individual basis at any time

6. The operator shall be able to display or print all parameters associated with a particular demand meter on request

7. The power demand program shall operate on a sliding window basis. Each minute shall be considered to be in the middle of the cycle interval. The demand data shall be gathered each minute. The data from the last N minutes (where N equals one-half the interval length) shall then be used to create a best fit first-degree polynomial curve. The curve shall then be examined at what would be the end of the interval (N minutes ahead). If this value is greater than the shed limit, the power demand program shall calculate the excess load and initiate load shedding. The shedding shall begin with the lowest priority loads and shall be governed by the point's minimum on time, maximum off time, point disability, and status of the space temperature point (if one has been defined). If the point has not satisfied (continuously) its minimum on time, if the maximum off time has already been reached, if the point is disabled, or if the space temperature point is in alarm, the load initially shall not be shed. If the power demand program finds that it has examined all loads in all priorities and more shedding is still necessary, according to the predicted load, it shall go back to the lowest level and re-examine the points, this time overlooking the status of space temperature points. If it is still unable to adequately reduce the load level, the operator shall be informed of the number of kilowatts still needed to be shed. Under no circumstances shall the system shed a load if the point's minimum on time has not been satisfied or if the point is disabled.

8. If at any time after load shedding has been initiated, the system forecasts the end of cycle consumption to be below the restore limit, the power demand program shall begin starting up the loads in order to bring the system back into the state in which it was operating before the shedding began. Load restoration shall be performed in inverse order from that observed in the shedding process. The first group of points to be restored shall consist of those whose sample area is in alarm. The second group shall be the remainder of the power demand monitored points that are currently off and have met their minimum off time. Under no circumstances shall the power demand program restore a point that is either disabled or has not yet satisfied its minimum off time. The starts shall be performed in an efficient manner, each being delayed by the amount of time specified by the preceding point within the same controller. When enough load has been restored so that the forecasted consumption is above the restore limit, the power demand program shall discontinue the restoration process.

9. Points that are both duty cycled and power demand monitored may be shed by the power demand program, but shall only be started up by the duty cycler. If the duty cycler deems it necessary to start such a point, it shall determine whether the point is off due to load shedding or normal cycling. If the point was shed and an entire power demand program interval has not elapsed since the time of the shed, the duty cycler shall then locate and shed enough other load to allow the original point to be started, without affecting the total system power consumption.
10. A power demand profile shall be available to the operator upon request. The profile shall be displayed or printed by operator selection. The profile shall include the demand meter description, the time, date, demand limit, restore limit, interval length, current demand, highest demand today and time of occurrence, highest demand yesterday and time of occurrence, highest demand during current billing period with time and date of occurrence, and the highest demand for the last 11 billing periods by billing period with time and date of occurrence. Billing periods shall be able to be defined by the operator through the operator’s terminal.

L. Mixed Air Enthalpy Control: The system shall calculate the enthalpy of the outside air and the return air of each air handling unit assigned to the program. The program shall use the logic required as defined in the sequence of operations.

M. Optimum Start Time: The optimum start program shall calculate the latest start time for air handling units in each operator-defined zone. The calculations shall consider occupancy time, outdoor temperature, indoor temperature, desired indoor temperature at occupancy, the capacity of the air handler(s), and the zone’s heat gain/loss rate.

1. The program shall run at a reschedule interval of no more than five minutes beginning at an hour that is certain to be before the start-up time for all of the optimum start zones. The program shall examine each zone at the frequency defined for that zone.

2. When the program determines that the optimum start time has been reached, it shall start all of the air handling units included in the zone definition.

3. At the zone occupancy time, the system shall record the actual zone temperature and any deviation from desired temperature. If any unit within the zone was found to have been off-line between the startup time and the occupancy time, the data shall be flagged as invalid.

4. Optimum start zones shall be defined by the operator through the operator’s terminal. Parameters shall include as a minimum:

   a. Occupancy time for each day of the week
   b. Desired temperature at occupancy during heating season
   c. Desired temperature at occupancy during cooling season
   d. Whether the zone is on cooling, heating, or both
   e. Acronym of outdoor temperature sensor
   f. Acronym of indoor temperature sensor
   g. Acronym(s) of air handler(s) to be started
   h. Acronym of the zone
5. The operator shall be able to modify the parameters at any time. A summary of the zone parameters shall be available on command. The summary shall be displayed on the operator's terminal or printed on the data logger. This summary shall detail the conditions presented to the optimum start program as well as the results of the optimum start function for one week. The information, output by zone, shall include the difference between the target temperature and both the inside and outside air temperatures at the zone start time, the difference between the target temperature and the actual room temperature at occupancy time, and the start time measured in minutes before occupancy. Performance summaries shall be able to be requested for individual or multiple zones.

N. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization

2.11 GRAPHICAL USER INTERFACE SOFTWARE

A. System Protection: A supervisory control system is used to control sensitive processes and costly equipment. Therefore, system protection is essential to prevent unauthorized actions on the system or accidental damage to the system. The following describes minimum required system protection capabilities.

1. Foreground Program Switching
   a. It shall be possible to configure the run-time system so as to prevent the operator from obtaining direct access to foreground program switching by disabling certain keys in the system. In this way, only the foreground program switching which is built into the end application shall be accessible to the process operator.

2. File Menu Access
   a. It shall be possible to configure the run-time system so as to prevent the operator from obtaining direct access to the File Menu or any other direct ability to open and close files outside of the desired built-in capabilities of the final operator interface application.

3. System Level Interface
   a. It shall be possible to provide password protection on a moveable mask that can cover the entire system level graphical user interface, including the operating system title bars, menu bars, etc. such that only authorized personnel would have access to this level of control. This protection is necessary to prevent lesser skilled personnel from causing damage to the operator interface application, from accidentally erasing files or records, or from accessing other software not directly connected with the desired plant monitoring and supervisory control application.

4. Operator Log-On
   a. It shall be possible to assign each operator a log-on password which defines a unique access level, thereby limiting access to various command functions based on the operator's access level. Multiple-level password access protection shall be provided to allow the Owner's authorized IAS Administrator to limit workstation control, display and database manipulation capabilities as IAS Administrator deems appropriate for each user, based upon an assigned user name with a unique password.
   b. Based on the operator's unique password, it shall be possible to log each operator's actions for later review.
c. It shall be possible to define an inactivity time span between operator actions on the system, requiring the operator to log on again with his password. This capability is useful in preventing unauthorized access to the operator interface system while an operator is away from his station performing other duties.

d. All passwords for the system shall be provided to the Owner including administrator, dealer, or factory level passwords for the systems provided under this Project.

e. Passwords shall restrict access to all Controllers.

f. A minimum of 250 user names shall be supported per Owner’s direction.

B. Alarm and Event Management Reporting

1. Alarm Display Capability:

a. System shall support displaying of alarms on any display as a user defined sizable object, which may be placed by itself or along with other objects in a window. It shall be possible to scroll forward or backward through the alarm displays by depressing command buttons. Current Alarms shall be available as an Alarm Summary Object and a chronological summary of Alarms shall be available as an Alarm History object.

b. The operator shall be able to select the alarms displayed by an object alarms by group and/or priority by using command buttons. Up to 999 priority levels shall be supported.

c. The system shall support an unlimited number of alarm displays.

d. Alarms shall be color coded according to the state of the alarm, including an acknowledged alarm, unacknowledged alarm, and an alarm that has returned to normal, but is not yet acknowledged. The user shall be able to choose from 32 different colors for display of each of these alarm states. The alarm display object may also support event display with the color used for events also being one of the 32 different colors.

e. The alarm display shall support the display of the following alarm parameters, which are user selectable in the configuration mode:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Alarm (HIHI, LOLO, etc.)</td>
<td>Value of Variable in Alarm</td>
</tr>
<tr>
<td>Operator Name</td>
<td>Alarm Priority</td>
</tr>
<tr>
<td>Alarm Group Name</td>
<td>Comment</td>
</tr>
</tbody>
</table>

f. It shall be possible to configure the system such that the operator is notified of an alarm no matter what display he or she is currently viewing. Notification shall include the option of a pop-up alarm display window, a flashing process symbol, such as a process vessel, an alarm text message that is available on each display, or a dedicated alarm display window on the screen.

g. The user shall be able to display alarms on an individual or a group basis, with support for sixteen (16) groups, each having up to sixteen (16) subgroups. The alarm hierarchy shall be capable of being nested up to eight (8) levels deep.
h. It shall be possible to inform the operator of an alarm condition via an audible tone, a pop-up display, or any combination of animation types on the screen. Alarm acknowledgment may be performed on all alarms, alarms in a single group, alarms in a collection of groups as defined in an alarm group hierarchy or on a point-by-point basis.

2. Alarm File Capability:
   a. Alarms shall be logged to a file for future viewing or review of alarm history data. The user shall have the capability to review the file for cause and event analysis.
   b. The alarms that are logged shall be configurable from a choice of the parameters.

3. Alarm Printing Capability:
   a. Alarms shall be printed to a printer using either a serial or parallel interface. The format of the alarm printout shall be configurable. All alarms shall be capable of being printed to either a local or a remote network printer.

4. Alarm Transmission Capability:
   a. Alarms shall be transmitted over the Owner’s secure internal wide area network.
   b. Each alarm shall be associated with a priority level and unique user-defined list of operator devices including any combination of local or remote workstations, printers, workstation disk files, e-mail addresses, and pagers. All alarms associated with a given priority level shall be routed to all operator devices on the user-defined list associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.

5. Events:
   a. Events shall be logged for review by the operator, engineering or management personnel. The system shall log each new operator log-on, and whenever an operator changes a set-point or turns any device on or off. Each time the event log records an event, it will record the operator logged in and the type of action taken (set-point change, state change, etc.), along with a date and time stamp.

C. Real-Time and Historical Trending

1. The software shall display real-time and historical data in both a tabular and graphical format. The requirements of this trending shall include the following:
   a. Provide trends for all physical points, virtual points and calculated variables.
   b. In the graphical format, the trend shall plot at least four (4) different values for a given time period superimposed on the same graph. The four (4) values shall be distinguishable by using unique colors. In printed form the four (4) lines shall be distinguishable by different line symbology. Displayed trend graphs shall indicate the engineering units for each trended value.
   c. The sample rate and data selection shall be selectable by the operator.
   d. The trended value range shall be selectable by the operator.
   e. Where trended values on one table/graph are COV, software shall automatically fill the trend samples between COV entries.
f. Real-time trend displays shall support the use of expressions of tag names including add, multiply, divide, etc., to permit proper scaling of variables.

g. Historical trend display should allow the user to zoom in and out in time from 1 minute up to 6 weeks in one display. It shall be possible to activate the zoom-in and zoom-out features using action scripted command buttons available to the operator.

h. The operator shall have the capability to pan backward and forward in time to view historically logged data.

i. Historically collected data shall be available to be exported to a spreadsheet format for analysis, additional reports, etc.

j. Control Loop Performance Trends: Controllers incorporating PID control loops shall also provide high resolution sampling in less than six second increments for verification of control loop performance.

k. Data Buffering and Archiving: Trend data shall be buffered at the JACE and/or CSS, and uploaded to hard disk storage when archival is desired. All archived trends shall be transmitted to the on-Site OWS or CSS as applicable. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.

l. Time Synchronization: Provide a time master that is installed and configured to synchronize the clocks of all IAS devices supporting time synchronization. All trend sample times shall be able to be synchronized.

D. Data Acquisition and Storage

3. The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the IAS.

4. The database shall be ODBC or OLE database compliant. Provide a commercially-available ODBC driver or OLE database data provider, which would allow applications to access the data via Microsoft Windows standard data access services.

5. Enterprise level data archiving shall be performed through the District’s Microsoft SQL Server residing on the IAS server and XML text formats.

E. Totalization

1. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management-reporting functions.

2. Totalization of electricity use/demand shall allow application of totals to different rate periods, which shall be user definable.
3. When specified to provide electrical or utility Use/Demand, the Contractor shall obtain from the local utility all information required to obtain meter data, including k factors, conversion constants, and the like.

F. Equipment Scheduling

1. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.

2. All operators shall be able to view the entries for a schedule. Operators with sufficient privilege shall be able to modify schedule entries from any workstation.

3. Scheduling feature shall include multiple seven-day schedules, plus holiday schedule, each with start time and stop time. Schedules shall be individually editable for each day and holiday.

4. Scheduling feature shall allow for each individual equipment unit to be assigned to one of the schedules.

5. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time. A password level that does not allow assignment of schedules shall allow a timed override feature.

6. A yearly calendar feature shall allow assignment of holidays, and automatic reset of system real time clocks for transitions between daylight savings time and standard time.

G. Point Naming Convention:

a. Request IAS point naming convention from the District prior to the generation of the required IAS shop drawings.

H. User Input/Control Functions

1. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above. The intent of this Specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.

2. The operator shall be able to access displays via a pointing device and/or soft key menus with a choice of function keys, cursor control keys, or any key on the keyboard. Supported pointing devices shall include a mouse, touch screen, light pen, or trackball.

3. The system shall support operator access to multiple displays at one time, including split screens where the operator may view more than one process area at a time. In addition, the system shall support unlimited use of pop-up displays for additional help or diagnostic information.

4. Access to all displays and to all command functions shall be based on the operator’s security level to protect against unauthorized use. The security level shall be established during the operator sign-on procedure.

5. Visibility and operation of command buttons, symbols, etc. shall be controllable based upon the operator’s security level.

6. The operator shall be able to have access to context sensitive help at any time during operation of the system.
7. Graphic software shall provide for multitasking such that third-party programs can be used while the OWS software is on line. Software shall provide the ability to alarm graphically even when operator is in another software package.

8. An operator shall be able to control a discrete point using an action command button. This control includes momentary on, momentary off, toggle on-off, set, and reset.

9. The operator shall be able to use command buttons to adjust set-points up and down on a percentage or absolute basis. Each request for increase or decrease shall be evaluated against valid operating limits before allowing the adjustment.

10. Control of individual set-points shall be enabled based upon a user’s security level and password.

I. Display Capability

1. The software shall allow for Owner creation of user-defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be capable of displaying all point information from the database including any attributes associated with each point (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.

2. The system shall allow the user to view animated graphics for process templates including tanks, pumps, etc. This includes:
   a. 3 dimensional (3D) HVAC floor plans shall be produced by the IAS contractor as shown in the sample provided in Guideline A.
   b. HVAC floor plans shall be provided with dynamic coloring and opacity by zone.
   c. Percentage fill of the object including irregular shapes such as polygons, ellipses, etc.
   d. Color change of the object. Up to 32 colors.
   e. Blinking of the object based upon any alarm in the system or upon a designated group of alarms.
   f. Each object shall have a visibility attribute option allowing for visibility of the object based upon a condition in the system.
   g. The system shall support animation of objects via resizing, moving, and/or rotating objects based upon a change in a process variable.
   h. Objects shall be animated based upon any user-defined criteria made up of other tag-names in the system. This includes the use of expressions containing all mathematical functions and the status of analog and discrete values in the system.
   i. Objects shall be able to be animated according to any of eight (8) different alarm conditions for an analog variable, including:

      Lo Alarm    LoLo Alarm
      Hi Alarm    HiHi Alarm
      Rate of Change Normal State
   j. Objects shall be able to blink or change color by evaluating any of the 32 bits in an analog register. Up to 32 colors shall be possible.
3. The system shall support the capability for the operator to view scanned images from
desktop or hand-held scanners. It shall be possible to animate these images to show a
color change based on the status of process operations, including alarm or normal state.

4. Screen Penetration: The operator interface shall allow users to access the various
system graphic screens via a graphical penetration scheme by using the mouse to select
from menus or ‘button’ icons. Each graphic screen shall be capable of having a unique
list of other graphic screens that are directly linked through the selection of a menu item
or button icon.

5. Dynamic Data Displays: Dynamic physical point values shall automatically updated at a
minimum frequency of six (6) updates per minute without operator intervention. Point
value fields shall be displayed with a color code depicting normal, abnormal, override and
alarm conditions.

6. Point Override Feature: Each displayed point shall be individually enabled/disabled to
allow mouse-driven override of digital points or changing of analog points. Such
overrides or changes shall occur in the control unit, not just in the workstation software.
The graphic point override feature shall be subject to password level protection. Points
that are overridden shall be recorded as an event, and shall be displayed in a coded
color. The event message shall include the operator’s user name.

7. System shall support use of true-type scalable fonts that may be scaled according to the
desired size of the text. The fonts shall be loaded by the operating system. The user
may choose from up to 32 different text colors.

8. System shall support change of text color based upon the process value going into eight
(8) different alarm states.

9. Text shall be able to blink based upon any user definable condition occurring in the
system, such as an alarm on a particular setpoint, alarm on any value in a process group,
or based on the actual value of a process variable.

10. System shall display process values based upon the security level of the user.

11. Text shall be able to be made visible or invisible based upon an alarm condition in the
process or any other state change in the system.

12. Graphics Development Package: Graphic development and generation software shall be
provided to allow the user to add, modify, or delete system graphic displays.

13. The Contractor shall provide libraries of pre-engineered screens and symbols depicting
standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.),
mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.),
complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and
electrical symbols.

14. The Graphic Development Package shall use a mouse or similar pointing device to allow
the user to perform the following:
   a. Define symbols.
   b. Position items on graphic screens.
   c. Attach physical or virtual points to a graphic.
   d. Define background screens.
   e. Define connecting lines and curves.
f. Locate, orient and size descriptive text.

g. Define and display colors for all elements.

h. Establish correlation between symbols or text and associated system points or other displays.

i. Create hot spots or link triggers to other graphic displays or other functions in the software.

PART 3 - EXECUTION

3.01 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure IAS system software, supplemental software, network communications, CSS, OWS, remote operator workstations, portable operator's terminal, printer, and network communications.

B. Contractor shall, after all hardware (devices / nodes and wiring) has been installed, provide all necessary device installation, device configuration, device programming, device diagnostics, network variable binding, alarm management and systems diagnostics. The contractor shall also provide the software tools necessary to perform these services. The software tools shall be registered to the owner.

C. Utilize a protocol analyzer tool to monitor network traffic on all installed DLN control channels for a minimum of 24 hours per channel. Furnish additional hardware and/or reconfigure nodes as necessary to maintain traffic to at least 50% of channel bandwidth capacity or a maximum of 70% of the available resources in the Niagara controller.

D. Contractor shall start-up, test, and set all parameters. The Contractor shall demonstrate compliance with all requirements herein. All damaged or malfunctioning software/hardware shall be replaced.

E. Final adjustments shall be performed by specially trained personnel in the direct employment of the Contractor.

   1. All graphics and alarm monitoring shall be operational and demonstrated before final acceptance

3.02 SITE-SPECIFIC APPLICATION PROGRAMMING

A. Provide all database creation and Site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Provide Site-specific application programming and thoroughly document programming. Meet the intent of the written sequence of operation. It is the Contractor’s responsibility to request clarification on sequence issues.

B. All Site-specific programming shall be fully documented and submitted for review and approval, prior to downloading into the panel, at the completion of functional performance testing, and at the end of the Warranty Period.

C. All programming, graphics and data files must be maintained in a logical system of directories. All file names shall adhere to the naming convention format as established in the Owner’s Standard Acronyms documentation. All software applications, programs, databases and files developed for the Project will be the property of the Owner, will be licensed to the Owner and shall remain on the workstation(s)/server(s) at the completion of the Project.
3.03 PASSWORD SETUP

A. Follow District Standard password setup schemes.

3.04 POINT PARAMETERS

A. Provide the following minimum programming for each analog input:
   1. Name
   2. Address
   3. Scanning frequency or COV threshold
   4. Engineering units
   5. Offset calibration and scaling factor for engineering units
   6. High and low alarm values and alarm differentials for return to normal condition
   7. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values
   8. Selectable averaging function that shall average the measured value over a user selected number of scans for reporting

B. Provide the following minimum programming for each analog output:
   1. Name
   2. Address
   3. Output updating frequency
   4. Engineering units
   5. Offset calibration and scaling factor for engineering units
   6. Output Range
   7. Provide the following minimum programming for each digital input:
   8. Name
   9. Address
   10. Engineering units (on/off, open/closed, freeze/normal, etc.)
   11. Debounce time delay
   12. Message and alarm reporting as specified
   13. Reporting of each change of state, and memory storage of the time of the last change of state
   14. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions

C. Provide the following minimum programming for each digital output:
1. Name  
2. Address  
3. Output updating frequency  
4. Engineering units (on/off, open/closed, freeze/normal, etc.)  
5. Direct or Reverse action selection  
6. Minimum on-time  
7. Minimum off-time  
8. Status association with a DI and failure alarming (as applicable)  
9. Reporting of each change of state, and memory storage of the time of the last change of state  
10. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions  

### 3.05 HISTORICAL DATA LOGGING

A. Historical data logging shall be configured and located in the Niagara 4 JACE and archived in the Niagara 4 Supervisor per the owner’s requirements.  

B. Archival of the trend logs shall be based on time of day. Stagger archival of each campus JACE so that no two JACE network supervisors ever archive to the server at the same time.  

C. Contractor shall establish and store trend logs. All points shown on the IAS drawings shall be trended at a minimum 15 minute interval for a period of 1 year before being overridden. All associated setpoints shall be trended as well. Fixed setpoints may be trended with change-of-value (COV) intervals. Setpoints with resets shall be trended at 15 minute intervals.  

D. The Owner will analyze trend logs of the system operating parameters to evaluate normal system functionality. Contractor shall establish these trends and ensure they are being stored properly.  

E. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field or single date stamp. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate 2-dimensional formats with time being the row heading and field name being the column heading.  

F. Sample times indicated as COV (±) or change-of-value mean that the changed parameter only needs to be recorded after the value changes by the amount listed. When output to the trending file, the latest recorded value shall be listed with any given time increment record. The samples shall be filled with the latest values also if the points include different time intervals.  

G. Trending intervals or COV thresholds shall be dictated by the Owner upon system start-up.  

H. The Contractor shall demonstrate functional trends as specified for a period of 30 days after successful system demonstration before final acceptance of the system.  

### 3.06 TREND GRAPHS

A. Prepare controller and workstation software to display graphical format trends. Trended values and intervals shall be the same as those specified.
B. Lines shall be labeled and shall be distinguishable from each other by using either different line
types, or different line colors.

C. Indicate engineering units of the y-axis values; e.g. degrees F., inches w.g., Btu/lb, percent
open, etc.

D. The y-axis scale shall be chosen so that all trended values are in a readable range.

E. Trend outside air temperature, humidity, and enthalpy during each period in which any other
points are trended.

F. All points trended for one HVAC subsystem (e.g. air handling unit, chilled water system, etc.)
shall be trended during the same trend period.

G. Each graph shall be clearly labeled with variables, date, and times.

3.07 ALARMS

A. The IAS Provider is required to submit a point summary to confirm point names as specified
herein. The IAS Provider shall submit this point summary with the addition of identifying all
alarms which includes detail information on the alarm parameters to the Owner for approval
prior to the beginning of any Commissioning process of the integrated automation system.

B. The Owner shall grant approval of alarms by issuing the approved alarms to the Contractor. The
approved alarms issued to the Contractor shall be used for the Functional Test Procedures
alarms tested. The Contractor shall initiate the start of this process immediately after IAS
submittal has been approved and monitor the progress to ensure the construction schedule is
not delayed.

C. Analog Input Alarms:

1. Duct Static Pressure:
   a. Alarm @ +(-) 0.3 inches from set point for 5 minutes @ Priority 3
   b. Normal @ +(-) 0.2 inches from set point for 5 minutes
   c. Alarm is active after fan is proven ON for the minimum time necessary to allow the
      sensor to be within the alarm parameter
   d. Alarm is deactivated after fan is proven OFF

2. Duct Air Temperatures:
   a. Alarm @ +(-) 2.0 degrees F from set point for 5 minutes @ Priority 3
   b. Normal @ +(-) 1.0 degrees F from set point for 5 minutes
   c. Alarm is active after fan is proven ON for the minimum time necessary to allow the
      sensor to be within the alarm parameter
   d. Alarm is deactivated after fan is proven OFF

3. Space or Room Temperature:
   a. Submit as not alarmable and Owner will confirm

4. Duct or Space Humidity:
   a. Alarm @ (+) 15 percent from set point (60 percent) for 5 minutes at Priority 3
b. Alarm @ (-) 20 percent from set point (60 percent) for 5 minutes at Priority 3

c. Normal @ 5 percent from offset alarm parameters for 5 minutes

d. Point is always ready to alarm.

5. Water temperature sensors which are inputs to control loops:

a. Submit reasonable alarm parameter to prevent nuisance alarming at Priority 3.

b. Owner will confirm alarm.

6. All other Analog Inputs:

a. IAS Provider shall utilize their expertise and recommend not less than three (3) analog input alarms which protect the Owner’s best interests.

b. Submit at Priority 3 with recommended alarm parameters.

c. Identify recommended alarms in submittal.

d. Owner will confirm alarm.

D. Digital Input Alarms:

1. Proofs (current sensor, air flow switches, water differential pressure switches etc).

a. Digital inputs paired with BAS digital output will have the ability to alarm at all times at Priority 3.

b. Alarm will delay for the reason time needed when the state of the digital output changes to prevent nuisance alarms

c. Point is in alarmed condition when the value of the digital input does not equal the value of the digital output after the time delay

d. Point is in the Normal condition when the value of the digital input equals the value of the digital output after the time delay

e. Digital input proofs without a paired digital output shall not alarm and be for monitoring purposes only.

2. Safeties (high static cutout, freeze condition, excessive vibration, high humidity cutout, VFD fault, etc.).

a. The digital input shall be always ready to alarm without delay

b. The digital input shall display “ALARM” at Priority 3 at the Alarm screen when activated.

c. The digital input shall display “NORMAL” at the Alarm screen when deactivated.

3. Monitoring Digital Inputs (auxiliary drain pan alarm, Unit general alarm, water detector, etc) the exception is air filter differential pressure switch.

a. All digital inputs which “deactivated” is the normal state of planned operations shall alarm when the normal state of planned operation changes

b. The digital input shall display “ALARM” at Priority 3 at the Alarm screen when activated
c. The digital input shall display “NORMAL” at the Alarm screen when deactivated

4. Air Filters:
   a. Submit as not alarmable and Owner will confirm.
   b. The digital input shall display “DIRTY” when activated.
   c. The digital input shall display “CLEAN” when deactivated

E. Analog Output Alarms:
   1. All Analog Outputs:
      a. IAS Provider shall utilize their expertise and recommend any analog output alarms which protect the Owner’s best interests.
      b. Identify recommended alarms in submittal.
      c. Owner will confirm any alarms.

F. Digital Output Alarms:
   1. Refer to digital inputs paired with digital outputs as specified herein.
   2. All Digital Outputs:
      a. IAS Provider shall utilize their expertise and recommend any digital output alarms which protect the Owner’s best interests.
      b. Identify recommended alarms in submittal.
      c. Owner will confirm any alarms.

G. Nuisance Alarms: All alarms which have been identified by the Owner as a nuisance alarm due to numerous times in and out of alarm, shall be addressed and corrected by the Contractor in a manner that the Owner has approved.

H. See requirements for additional equipment-specific alarms specified in the Contract Documents.

3.08 GRAPHIC SCREENS

A. The general look, feel and functionality of the interface has been established for all equipment and functions included in the scope of work. The Contractor shall review the existing graphic standards in terms of visual appearance and functionality and shall generate a GUI which is in full compliance with the look and functionality defined in the standards. The Owner shall be the final authority for system compliance with this requirement.

B. The Contractor shall use identical graphics, features and logic from the Graphics Requirement Exhibit standards to replicate new system graphics for the GUI development.

C. For systems which do not have existing graphics standards the Contractor shall generate new graphics which are similar in nature, look and function to the Niagara 4 Graphics Requirement Exhibit Document. The Contractor shall submit all graphics to the Owner and engineer for approval prior to replicating for each piece of equipment.

D. The Contractor shall provide graphs, trends, logs and system links for all components as defined in these design documents.
E. The Contractor shall develop the GUI in accordance with all rules and guidelines for development as set by the manufacturer. This shall include following all guidelines for bundles, nested bundles, interstation links, network management, and the rules and guidelines defined by Tridium.

F. The Contractor shall develop individual graphics and web pages for the following system components. Actual Design Document Revit or BIM files for risers, floor plans and details may be incorporated into the GUI development if acceptable to the project Engineer and the District. Contact the Owner and sign required waivers to gain access to these files.

1. Provide graphic floor plan screens for each floor of each building.
   a. The contractor shall develop three-dimensional floor plans for each floor for use on the HVAC floor plan controls. The floor plans shall be generated using AutoCAD 3DSMax or equal, and shall match the style of the exiting graphical user interface.
   b. Indicate the location of all equipment that is not located on the equipment room screens.
   c. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens.
   d. The IAS contractor shall configure the system to provide the user with a minimum of 4 options to view the HVAC floor plans:
      1) Dynamic gradient color/opacity by zone temperature (more blue for cold and more red for hot).
      2) Dynamic gradient color / opacity by zone temperature offset from setpoint (more blue for below setpoint and more red for above setpoint).
      3) Dynamic gradient color/opacity by zone heating cooling demand.
      4) Dynamic gradient color / opacity by zone occupancy (more opaque for zones with longer occupied states; less opaque for zones with shorter occupied states).
   e. Include a spectrum legend and any global HVAC floor commands.
   f. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone.
   g. Mechanical floor plan Drawings will be made available to the Contractor upon request for the purpose of determining zone boundaries. Indicate room numbers as provided by the Owner.
   h. Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the floor plan graphic screens to each corresponding equipment schematic graphic screen.

2. Provide graphic floor plan screens for each mechanical equipment room. Indicate the location of each item of mechanical equipment. Provide a drawing link from each equipment symbol shown on the graphic plan view screen to each corresponding mechanical system schematic graphic screen.
3. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.

4. Provide a graphic Site plan with links to and from each building plan.

G. System Schematic Screens: Provide graphic system schematic screen for each subsystem controlled with each I/O point in the Project appearing on at least one graphic screen. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc. as applicable. General layout of the system shall be schematically correct. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked-setpoint screen.

H. Provide graphic screens for each AHU. Indicate outside air temperature and enthalpy, and mode of operation as applicable (i.e., occupied, unoccupied, warm-up, cool-down). Link screens for air handlers to the heating system and cooling system graphics. Link screens for supply and exhaust systems if they are not combined onto one screen.

I. Use Toolbar at top of each screen page to provide equipment information, Server Time/Date, OAT, OARH, Chiller Temp, and to provide hyperlink access to Alarms, Charts, Calendar, Emergency Stop.

J. Provide a graphic screen for each zone. Provide links to graphic system schematic screens of air handling units that serve the corresponding zone.

K. Provide summary graphics for multiple zones for each floor (e.g. VAV zones).

1. Columns in the Summary shall indicate VAV Name, Space Temp, Setpoint, Occupied Mode, Heat Setpoint, Cool Setpoint, Actual Airflow, Max Airflow Setpoint, Cooling Damper Percent, Minimum Airflow Setpoint, and Heating Damper Percent.

2. Rows in the Summary shall indicate the data from a single VAV box

3. Each row shall be overlaid with a hyperlink to the individual VAV Box Graphic

4. Each row shall include a background which will turn red upon any VAV alarm, thus serving as an alarm summary page

5. Each row shall include a background which will turn yellow upon any VAV parameter placed in Override, thus serving as a reminder to return parameters to Automatic

6. The Menu shall allow direct hyperlink to this graphic from “Floors / Floor XX / Area Summary” item>

7. Link screens for heating and cooling system graphics to utility history reports showing current and monthly electric uses, demands, peak values, and other pertinent values.

8. Individual Power Meter Graphic

   a. Provide detailed metering page for each power meter installed as part of this project. Classify these per floor.
b. Each page shall indicate power meter status, voltage, amperage, power, energy, demand, and power factor for each phase of each meter.

c. Meets ANSI C12.20 Accuracy Standard

d. Each of these components shall be logged, with Chart buttons provided for fast hyperlink to associated log chart.

e. The Menu shall allow direct hyperlink to this graphic.

9. Provide graphic animation for the following objects:

   a. Damper position
   b. Fan status
   c. Cooling and Heating Coils
   d. Lighting zones

L. Alarms: Each programmed alarm shall appear on at least one graphic screen. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, chiller alarm shall be shown on graphic cooling system schematic screen). For all graphic screens, display analog values that are in a ‘high alarm’ condition in a red color, ‘low alarm’ condition in a yellow color. Indicate digital values that are in alarm condition in a red color.

END OF SECTION
SECTION 259500

INTEGRATED AUTOMATION CONTROL SEQUENCES FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

1.3 DEFINITIONS

A. CAV: Constant Air Volume.
B. DDC: Direct-Digital Controls.
C. VAV: Variable Air Volume.
D. VFD: Variable Frequency Drive
E. CHW: Chilled Water
F. HHW: Heating Hot Water

1.4 GENERAL

A. Equipment start stop and Software Interlocks
   1. Mechanical equipment shall be operated, controlled and monitored by the DDC system using the input/output (I/O) shown on the drawings. The operation of the equipment shall be subject to the operational modes, conditions and logic described in this Section. A time delay shall be initiated on system command for equipment start to allow status feedback devices to actuate. At the expiration of the time delay, absence of the run status input signal, which indicates a failure to start or to continue to run, shall cause the system to alarm and start standby units as required. The system shall not restart until commanded to “return to normal”. Alarms assigned to analog inputs shall be delayed on equipment startup to allow sufficient time for equipment capacity to bring the process variable values within the normal range. Variable capacity fans shall always start in an “unloaded” condition.
   2. HAND-OFF-AUTO switches shall be monitored to generate a critical alarm (an alarm that must be acknowledged) when the switch is indexed out of the “AUTO” position.
   3. Supply air, return air and exhaust air fans serving the same spaces shall be interlocked by means of software.
   4. The fire alarm system shall interface with the DDC system by means of digital outputs (DO) from the fire alarm system connected to the digital inputs (DI) of the DDC system at a single location.
   5. Whenever equipment is put into operation automatically, the DDC control loops shall be activated. When equipment is not operating, control loops shall be deactivated and end
elements shall go to their normally open or normally closed positions as shown on the contract drawings unless otherwise specified.

B. Equipment Staging and Rotation

1. Parallel devices shall be lead/lag rotated to maintain even wear.

2. Two runtime points shall be defined for each device:
   a. Lifetime Runtime: The cumulative runtime of the device since device start-up. This point shall not be readily resettable by operators.
   b. Staging Runtime: An operator resettable runtime point that stores cumulative runtime since the last operator reset.

3. Lead/lag devices: Unless otherwise noted, parallel staged devices (such as CHW pumps and cooling towers) shall be lead/lag alternated when more than one is off or more than one is on so that the device with the most operating hours as determined by Staging Runtime is made the last stage device and the one with the least number of hours is made the lead stage device.

4. Exceptions to Lead/lag and Lead/standby rotation
   a. Operators with appropriate access level shall be able to manually command staging order via software points, but not overriding the In Alarm or Hand Operation logic below.

C. Alarming Devices: If the lead device has a fault condition, a Level 2 alarm shall be generated and a response shall be triggered as defined below.

1. Alarm conditions shall be as follows:

2. Fans and Pumps
   a. Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds when device is commanded on

3. Boilers
   a. Shutdown alarm condition either through network or hardwired alarm contact, or
   b. HW isolation valve feedback indicates valve is not open 90 seconds after device is commanded open, or
   c. If its leaving water temperature remains 15°F below setpoint for 15 minutes

4. Upon identification of a fault condition:
   a. For pumps:
      1) The next commanded OFF device in the staging order, Device “B”, shall be commanded ON while alarming Device “A” remains commanded ON.
      2) If Device B fails to prove status (i.e. it also goes into alarm), it shall remain commanded on and the preceding step shall be repeated until the quantity of devices called for by the lead/lag logic have proven on.
      3) When either the required number of devices proves on or all devices are commanded on, set alarming devices to the last positions in the lead/lag staging order sequenced reverse chronologically (i.e. the device that alarmed most recently is sent to last position).
      4) Staging order of non-alarming devices shall follow the even wear logic. A device in alarm can only automatically move up in the staging order if another device goes into alarm.
      5) Devices in alarm shall run if so called for by the lead/lag staging order and present stage.
   b. For boilers:
      1) The next commanded OFF device in the staging order, Device “B”, shall be commanded ON while alarming Device “A” is commanded OFF and set to the last position in the lead/lag staging order.
      2) If Device B fails to prove status (i.e. it also goes into alarm), repeat the preceding step until the quantity of devices called for by the lead/lag logic have proven on.
3) Staging order of non-alarming devices shall follow the even wear logic. A device in alarm can only automatically move up in the staging order if another device goes into alarm.

4) Devices in alarm shall run if so called for by the lead/lag staging order and present stage.

D. Control of Damper, Valve, and Fan Speed
1. The DDC system shall apply P, PI or PID control by modulating analog outputs to the actuators in the proper direction to control temperature, humidity, pressure, flow and other process variables as specified.
2. All control and alarm setpoints shall be adjustable by the operator. Initial setting of all control and alarm setpoints shall be performed by the DDC system Contractor.

E. DDC System Failure
1. If Remote Control Panels (RCPs or ACPs) should fail, the operating equipment controlled by that panel shall continue to function, based on the last command.

1.5 MULTI-ZONE PACKAGED DX VAV UNIT CONTROL (AHU-1, 2, & 3):

A. The AHU shall be controlled through a manufacturer supplied BACnet BTL Listed Carrier RTU-Open controller and Carrier Linkage master controller fully integrated for remote control through the IAS system. The unit configuration settings and interface with the IAS control system are described below. All manufacturer configuration settings noted shall be integrated into the IAS system.

B. Occupancy- The packaged unit controller shall interface with the IAS for unit scheduling as follows:
1. The IAS system shall write to the linkage master multistate BACnet points Occupancy Mode (object ID keypad_ovrde) and Occupancy Scheduler Input (object ID’s CurrentState and NextState). Packaged Unit Controller occupancy state will be set by the Carrier linkage between the linkage master and the RTU-Open.
   a. The IAS shall schedule the linkage master controller based on input from the unit’s child VAV zone controllers. Allowable modes shall include Occupied, Unoccupied, Standby, Optimal Start Warm Up, and Demand Shed. Refer to zonal system sequences for details of each mode.
   b. Refer to Section I, Supervisory Control, for occupancy requirements of the IAS network supervisor.

C. Supply Fan Control- The packaged unit controller shall interface with the IAS for supply fan control as follows:
1. The VAV-RTU_Open supply fan shall be configured for Variable Speed Operation.
   a. Manufacturer Variable Speed Option description: “Fan speed is controlled to maintain the configured duct static pressure setpoint”
2. The IAS system shall write to the packaged units multistate BACnet point Fan Mode (Object ID fan_type) to configure the unit as continuous
   a. Manufacturer Continuous Option description: “The fan runs continuously during occupancy and intermittently during unoccupied periods with heating and cooling.”
3. The IAS system shall write to the packaged unit’s analog BACnet point Duct Static Pressure Setpoint (object ID sa_static_stpt).
   a. The supply fan control shall be configured in the unit controller to modulate the supply fan variable frequency drive to maintain duct static pressure at setpoint.
   b. Upon loss of network connection, the Duct Static Pressure shall failover to a local value established during TAB to meet design airflow conditions.
c. The IAS shall reset the duct static pressure setpoint (DuctStaticSP) based on AHU child zone damper positions. Refer to Section I, Supervisory Control, for duct static pressure reset requirements of the IAS network supervisor.

4. The packaged unit fan start-up and shutdown sequences shall be controlled by the packaged unit controller.

D. Cooling Capacity Control- The packaged unit controller shall interface with the IAS for cooling capacity control as follows:
   1. The IAS system shall write to the packaged unit’s multistate BACnet point Control Temperature Source (object ID CtrlTempSrc) to configure the unit for “None”
      a. Manufacturer None option description: “The cooling relays are controlled by the Cooling Control PID Loop and Cooling Capacity algorithm. They calculate the desired number of stages needed to satisfy the supply air temperature setpoint. When the cooling algorithm preconditions have been met, the compressors are energized in stages, as applicable.”
      b. During compressor operation, the VAV--RTU Open will reduce the number of active stages to only one if the rooftop supply air temperature falls below the Supply Air Setpoint. During mechanical cooling, should the SAT fall below the configured Minimum Cooling SAT value of 45_F, the economizer will modulate more open to maintain the minimum SAT. During integrated cooling, should the SAT fall below the configured Minimum Cooling SAT value of 45_F, the economizer will modulate more closed to maintain the minimum SAT.
      c. The IAS shall reset the Network Discharge Air Cooling Setpoint based on outdoor air conditions. Refer to Section I, Supervisory Control, for supply air temperature setpoint reset requirements of the IAS network supervisor.
   2. The packaged unit’s controller shall be configured to disable mechanical cooling when outdoor air temperatures fall below 55 deg F (Object ID oat_cl_lockout).

E. Economizer Control- The packaged unit controller shall interface with the IAS for economizer control as follows:
   1. The packaged unit’s controller shall be configured locally to based on the SAV Economizer Mode control strategy.
      a. SAV Economizer Mode - When the economizer mode becomes active, the fan runs at the configured minimum airflow (IDF Min Speed Voltage / Min VFD Output). The economizer algorithm will first modulate the economizer to lower the SAT until reaching the configured Minimum Cooling SAT limit, while maintaining the minimum fan airflow. If this alone is insufficient to maintain the space temperature, the RTU Open increases the fan speed to provide more OA for cooling. As necessary, the fan speed may increase up to the configured maximum VFD speed (IDF Max Speed Voltage / Max VFD Output) to provide the required cooling.
   2. The packaged unit controller shall monitor and report the following economizer fault conditions (Econo FDD) to the building automation system in accordance with California Title 24
      a. Fails to open- If the FDD logic detects an increase in damper position, for example from 50% to 65%, it expects to also detect a decrease in SAT. If the SAT failed to decrease, or no change in SAT is detected, the FDD logic generates a Failed to Open alarm after 10 minutes
      b. Fails to close- If the FDD logic detects a decrease in damper position, for example from 80% to 65%, it expects to also detect an increase in SAT. If the SAT failed to increase, or no change in SAT is detected, the FDD logic generates a Failed to Close alarm after 10 minutes.
      c. Stuck fully open- If the damper is commanded to < 40% and the SAT is still equal to the OAT +/- 5°F, the Stuck Open flag is set. If this condition continues for more than...
30 minutes, then the Economizer FDD alarm is active. This indicates the damper failed to close when needed, since the SAT failed to increase in temperature.

d. When the damper is modulating (MUST be above any minimum configured position) and between 25% and 100%, the FDD logic monitors the current and previous SAT, economizer-commanded position, and the OAT:

e. Fails to fully close- If the damper command is > 95%, the SAT must equal the OA temperature +/- 5°F, otherwise the Full Open Fail flag is set. If this condition continues for more than 30 minutes, the Economizer FDD alarm is active. This indicates that the damper failed to fully open when needed, since the SAT failed to reach the OA temperature +/- 5°F.

F. Minimum Outside Air Control - The linkage master unit controller shall interface with the IAS for Demand control ventilation as follows:

1. The IAS system shall write to the linkage master unit analog BACnet point space IAQ point (object ID system_iaq)
   a. based on the maximum CO2 sensor of all zones associated with the RTU.
2. The linkage master shall write to the VAV RTU-Open controller via Carrier Linkage.
3. The RTU Open controls IAQ using the unit economizer. The
   a. Manufacturer Space QIR Quality- As the air quality in the space decreases (Space AQ CO2 value increases), the minimum position of the economizer increases, allowing more outdoor air to enter the space. The amount of increase depends on the relationship between the Space AQ level and the DCV Max Ctrl Setpoint. The Space AQ algorithm calculates a minimum position value using a PID loop. The CO2 minimum damper position is then compared against the Vent Dmpr Pos / DCV Min Pos setpoint and the greatest value becomes the minimum damper position utilized for the economizer. When the minimum economizer position is being reset by the Space AQ algorithm, the System Mode displays IAQ Override. The maximum amount the economizer may be opened to outdoor air by the Space AQ algorithm is limited by the DCV Max Vent Damper Pos, which is adjustable between 10 and 75%.

G. Power Exhaust Fan Control - The packaged unit controller shall interface with the IAS for power exhaust fan control as follows:

1. The IAS system shall write to the packaged unit’s multistate BACnet point Continuous Occupied Exhaust Point (object ID Occ_ecx) to configure the unit for “Yes”
   a. The RTU Open shall energize the exhaust fan while the RTU-Open is in occupied mode and shall deenergize the power exhaust when the RTU-Open is in unoccupied mode.
2. The Power Exhaust fan VFD shall modulate using the same analog output point as the supply fan VFD. The contractor shall supply an analog signal splitter to route the AO signal to the power exhaust speed command.

H. Safety:

1. Discharge high static cutout, duct smoke detector, and supply fan VFD fault alarms shall de-energize the supply and power exhaust fans upon activation. All dampers and valves shall return to their normal position after the fans are de-energized.

I. Supervisory Control: The BACnet DDC control system shall interface with the packaged unit control system to schedule, trend, monitor run status and alarms, and supervise the packaged units. The DDC system shall provide the following supervisory control functions:

1. Occupied and Unoccupied Scheduling: The system shall be enabled based on a time-of-day (TOD) schedule and system demand as indicated by a zone temperature sensor indicating a zone has fallen outside of the unoccupied temperature setpoints, or as programmed by the building operator. Occupancy for systems serving areas scheduled...
through the 25 Live scheduling software shall be overridden by the network scheduling software for HVAC. System operation shall be allowed at all times.

2. Supply Air Temperature Reset – the DDC system shall command the packaged unit’s BACnet point Network Discharge Air Cooling Setpoint based on an outdoor air reset. The supply air temperature setpoint shall be adjusted in a straight-line relationship for the following conditions (all setpoints adjustable):
   a. 55°F when outside temperature is at or above 74°F.
   b. 65°F when outside temperature is at or below 66°F.
   c. Cooling shall be disabled when outside temperature is at or below 55°F.

3. Static Pressure Reset: The IAS shall command the packaged unit’s BACnet point Duct Static Pressure Setpoint based on system demand as indicated by terminal unit damper position. The supply static pressure setpoint shall be adjusted based on a trim and response strategy as follows (all setpoints adjustable):
   a. The static pressure setpoint shall be reset on 10-minute intervals (adj.) based on the most open terminal unit damper position in the building as described below
   b. Most open damper position is less than 95% open, the static pressure setpoint shall be reset upwards 0.01” (adj.)
   c. Most open damper position is greater than 98% open, the chilled water differential pressure setpoint shall be reset downwards 0.01” (adj.)

J. Operator Station Display: Indicate the following on the operator workstation display terminal (minimum requirements):
1. AHU System Graphic.
2. Occupied Schedules
3. Daily 25Live Schedule
4. Supply Air Temperature Setpoint
5. Outside Airflow Setpoint
6. Child Zone Space Carbon Dioxide Levels and Damper Positions
7. Duct Static Pressure Setpoint
8. Packaged Unit BACnet points to display in the main AHU system graphic:
   a. Active Cooling Stages (et_comp_run) - R
   b. Economizer Output (econ_output) - R
   c. Outdoor Air Temperature (oa_temp) - R
   d. Return Air Temperature (ra_temp) - R
   e. Static Pressure (static_press) - R
   f. Static Pressure Setpoint (sa_static_stpt) - R/W
   g. Supply Air Setpoint (sat_cl_stpt) - R/W
   h. Supply Air Temperature - Prime Variable (sa_temp) - R
   i. Supply Fan VFD (vfd_output) - R
   j. Occupancy Status (occ_status) - R
   k. Compressor Status (comp_alarm) - R
   l. Economizer Operation (econ_opr) - R
9. Packaged Unit BACnet points to display in a drill down table accessible through a link in the AHU system graphic:
   a. Compressor 1 Runtime (comp1_rntm) - R
   b. Compressor 2 Runtime (comp2_rntm) - R
   c. Cooling Lockout Temperature (oat_cl_lockout) - R/W
   d. DCV Max Ctrl Setpoint (iaq_stpt_max) - R/W
   e. DCV Max Vent Damper Pos (iaq_dpr_max) - R/W
   f. Economizer High OAT Lockout Temp (oat_ec_lockout) - R/W
   g. Effective Cool Setpoint (eff_cl_stpt) - R
   h. Effective Heat Setpoint (eff_ht_stpt) - R
   i. Fan Off Delay (fan_delay_off) - R/W
   j. Heat 1 Runtime (heat1_rntm) - R
### PACKAGED SINGLE-ZONE VAV UNIT CONTROL (AHU-4):

A. The AHU shall be controlled through a manufacturer supplied BACnet BTL Listed Carrier RTU-Open controller fully integrated for remote control through the IAS system. The unit configuration settings and interface with the IAS control system are described below. All manufacturer configuration settings noted shall be integrated into the IAS system.

B. Occupancy - The packaged unit controller shall interface with the IAS for unit scheduling as follows:

1. The IAS system shall write to the packaged unit's multistate BACnet points Occupancy Mode (object ID keypad_ovrde) and Occupancy Scheduler Input (object ID’s CurrentState and NextState). The IAS system shall sequence the unit occupancy among the following modes:
   a. Occupied: The controller monitors the room temperature sensor and modulates the supply air damper(s) in sequence with the reheat valve to maintain the room temperature at set point. Supply air volume remains at minimum when HW reheat valve is modulated.
   b. Unoccupied: The terminal unit is controlled using the night set points. The controller may reset to the occupied mode for a predetermined time period upon a signal from

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<td>Supply Fan Runtime (sfan_rntm_alarm)</td>
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the control system or manually at the room sensor. Manual activation at the room sensor shall enable operation of the AHU.

c. Standby: During normal time-of-day occupancy hours for zones scheduled through the network 25Live scheduling software, when the space is not scheduled for an event, the zone shall enter into Standby mode with independent temperature setpoints of 78°F cooling (adjustable) and 66°F heating (adjustable).

d. Optimal Start Warm-up Mode: Base the warm-up start time on an optimal start strategy calculated using outdoor air temperature and average zone temperature. If the average zone temperature is less than 69°F (adjustable), initiate the warm-up mode and set the Warm-up Mode Low Temperature Setpoint to 70°F (adjustable). Enable the air handling unit and terminal units for operation. Terminal units shall be operated in heating mode and operate to meet the warm-up mode low temperature setpoint.

e. Demand Shed: Upon receipt of a demand shed signal, all non-critical zones shall reset their heating setpoint down by 4°F and their cooling setpoint up by 4°F. The demand shed mode shall be manually enabled or disabled by an operator button on the graphical user interface as well as by an automatic campus signal.

C. Supply Fan Control: The packaged unit controller shall control the supply fan variable frequency drive.

1. The IAS system shall write to the packaged unit’s multistate BACnet point Fan Control (object ID fan_type) to configure the unit for “Variable Speed”
   a. Manufacturer Variable Speed Option description: “The supply fan airflow is controlled to maintain the Control Temperature at the Occupied Cooling Setpoint or the Occupied Heating Setpoint depending on the Unit State. Only applies if unit is configured for single zone VAV operation.”

2. The IAS system shall write to the packaged units multistate BACnet point Fan Mode (Object ID fan_type) to configure the unit as continuous
   a. Manufacturer Variable Speed Option description: “The supply fan airflow is controlled to maintain the Control Temperature at the Occupied Cooling Setpoint or the Occupied Heating Setpoint depending on the Unit State. Only applies if unit is configured for single zone VAV operation.”

3. The packaged unit fan start-up and shutdown sequences shall be controlled by the packaged unit controller.

D. Space Temperature Control- The packaged unit controller shall interface with the IAS for space temperature control as follows:

1. The packaged unit controller shall be configured in SAV Cooling Mode control strategy
   a. Manufacturer SAV Cooling Mode description: “Selects the temperature sensor input to be used for the unit heating/cooling changeover or zone cooling and heating capacity change decisions.”

2. The packaged unit’s controller shall be configured to disable mechanical cooling when outdoor air temperatures fall below 55 deg F. Carrier controller object oat_cl_lockout shall be set to 55 deg F.

E. Economizer Control- The packaged unit controller shall interface with the IAS for economizer control as follows:

1. The packaged unit’s controller shall be configured locally to based on the SAV Economizer Mode control strategy.
   a. SAV Economizer Mode - When the economizer mode becomes active, the fan runs at the configured minimum airflow (IDF Min Speed Voltage / Min VFD Output). The economizer algorithm will first modulate the economizer to lower the SAT until reaching the configured Minimum Cooling SAT limit, while maintaining the minimum fan airflow. If this alone is insufficient to maintain the space temperature, the RTU
Open increases the fan speed to provide more OA for cooling. As necessary, the fan speed may increase up to the configured maximum VFD speed (IDF Max Speed Voltage / Max VFD Output) to provide the required cooling.

2. The packaged unit controller shall monitor and report the following economizer fault conditions (Econo FDD) to the building automation system in accordance with California Title 24
   a. Fails to open- If the FDD logic detects an increase in damper position, for example from 50% to 65%, it expects to also detect a decrease in SAT. If the SAT failed to decrease, or no change in SAT is detected, the FDD logic generates a Failed to Open alarm after 10 minutes
   b. Fails to close- If the FDD logic detects a decrease in damper position, for example from 80% to 65%, it expects to also detect an increase in SAT. If the SAT failed to increase, or no change in SAT is detected, the FDD logic generates a Failed to Close alarm after 10 minutes.
   c. Stuck fully open- If the damper is commanded to < 40% and the SAT is still equal to the OAT +/- 5°F, the Stuck Open flag is set. If this condition continues for more than 30 minutes, then the Economizer FDD alarm is active. This indicates the damper failed to close when needed, since the SAT failed to increase in temperature.
   d. When the damper is modulating (MUST be above any minimum configured position) and between 25% and 100%, the FDD logic monitors the current and previous SAT, economizer-commanded position, and the OAT:
   e. Fails to fully close- If the damper command is > 95%, the SAT must equal the OA temperature +/- 5°F, otherwise the Full Open Fail flag is set. If this condition continues for more than 30 minutes, the Economizer FDD alarm is active. This indicates that the damper failed to fully open when needed, since the SAT failed to reach the OA temperature +/- 5°F.

F. Minimum Outside Air Control - The packaged unit controller shall interface with the IAS for outside air damper control as follows:
   1. The IAS system shall write to the packaged unit’s analog BACnet points Vent/Dmp Pos/DCV Min Pos (object ID econ_min) and Low Fan Econ Min Pos (object ID econ_min). These values will be determined during TAB.
      a. Manufacturer Description: The economizer minimum position is adjusted to provide a constant amount of outdoor air. If the fan is on high speed, the economizer minimum position will be set to the Vent/Dmp Pos/DCV Min Pos setpoint. If the fan is on low speed, the economizer minimum position will be set to the Low Fan Econ Min Pos.

G. Power Exhaust Fan Control - The packaged unit controller shall interface with the IAS for power exhaust fan control as follows:
   1. The IAS system shall write to the packaged unit’s multistate BACnet point Continuous Occupied Exhaust Point (object ID Occ_ecx) to configure the unit for “Yes”
      a. The RTU Open shall energize the exhaust fan while the RTU-Open is in occupied mode and shall deenergize the power exhaust when the RTU-Open is in unoccupied mode.
   2. The Power Exhaust fan VFD shall modulate using the same analog output point as the supply fan VFD. The contractor shall supply an analog signal splitter to route the AO signal to the power exhaust speed command.

H. Safety:
   1. Discharge high static cutout, duct smoke detector, and supply fan VFD fault alarms shall de-energize the supply and power exhaust fans upon activation. All dampers and valves shall return to their normal position after the fans are de-energized.

STUDENT SERVICES BUILDING
MiraCosta College - Community Learning Center
MCC Project 04001 | Lord Architecture Project 1707-100
INTEGRATED AUTOMATION CONTROL
SEQUENCES FOR HVAC
25 95 00 - 9
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I. Supervisory Control: The IAS shall interface with the packaged unit control system to schedule, trend, monitor run status and alarms, and supervise the packaged units. The IAS shall provide the following supervisory control functions:

1. Occupied and Unoccupied Scheduling: The system shall be enabled based on a time-of-day (TOD) schedule and system demand as indicated by a zone temperature sensor indicating a zone has fallen outside of the unoccupied temperature setpoints, or as programmed by the building operator. Occupancy for systems serving areas scheduled through the 25 Live scheduling software shall be overridden by the network scheduling software for HVAC. System operation shall be allowed at all times.

J. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):

1. System graphic(s).
2. Occupied Schedules
3. Daily 25Live Schedule
4. Space Temperatures and Setpoints
5. Space Carbon Dioxide Level and Setpoint
6. Outside Airflow Setpoint
7. Packaged Unit BACnet points to display in the main AHU system graphic:
   a. Supply Fan Status(sfan_status) - R
   b. Economizer Output(econ_output) - R
   c. Space Temperature - Prime Variable(space_temp) - R
   d. System Outdoor Air Temperature(system_oat) - R/W
   e. Active Compressor Stages(comp_run) - R
   f. Economizer Output(econ_output) - R
   g. Supply Air Temperature(sa_temp) - R
   h. Occupancy Status(occ_status) - R
   i. Setpoint(unocc_ht_stpt) - R/W
   j. Outdoor Air Temperature(oa_temp) - R
   k. BAS On / Off(keypad_ovrde) - R/W
   l. Compressor Status(comp_alarm) - R
   m. Reversing Valve Relay State(aux_1) - R
   n. Vent Dmpr Pos / DCV Min Pos(econ_min) - R/W
   o. Setpoint(occ_ht_stpt) - R/W
   p. System Space Temperature(system_spt) - R/W
   q. Fan / Speed(fan_run) - R
   r. Fan Control(fan_type) - R/W
   s. Fan Mode(fan_mode) - R/W
   t. Economizer High OAT Lockout Temp(oat_ec_lockout) - R/W
   u. Space Temp Sensor(spt_fail) - R
   v. Setpoint(occ_cl_stpt) - R/W
   w. Setpoint(unocc_cl_stpt) - R/W
   x. 
8. Packaged Unit BACnet points to display in a drill down table accessible through a link in the AHU system graphic:
   a. SA Vent / Temper Setpoint(tempering_stpt) - R/W
   b. VFD Speed Config(vfd_spd_cfg) - R/W
   c. Heating VFD Output(heat_vfd_spd) - R/W
   d. Supply Fan VFD Voltage(vfd_volt_output) - R
   e. Active Heat Stages(heat_run) - R
   f. Effective Cool Setpoint(eff_cl_stpt) - R
   g. High Space Temperature(spt_hi_alarm) - R
   h. Low Space Temperature(spt_lo_alarm) - R
   i. Supply Fan Relay State(sfan) - R
j. Supply Fan Status(sfan_status) - R
k. Outdoor Air Quality Sensor(oaq_fail) - R
l. DCV Max Vent Damper Pos(iaq_dpr_max) - R/W
m. System Mode(run_status) - R
n. DCV Max Ctrl Setpoint(iaq_stpt_max) - R/W
o. Occ Relative Humidity Setpoint(occ_dehum_stpt) - R/W
p. Optimal Start Type(start_type) - R/W
q. Economizer Test(econ_test) - R/W
r. Space Relative Humidity Sensor(sprh_sensor_fail) - R
s. Setpoint Adjustment(stpt_adj) - R
t. Effective Heat Setpoint(eff_ht_stpt) - R
u. Low Fan Econ Min Pos(econ_min_2) - R/W
v. Cooling Lockout Temperature(oat_cl_lockout) - R/W
w. Power Exhaust Setpoint(pexh_stpt) - R/W
x. System Space AQ(system_iaq) - R/W
y. Heating Lockout Temperature(oat_ht_lockout) - R/W
z. Safety Chain(safety_alarm) - R
aa. Unocc Relative Humidity Setpoint(unocc_dehum_stpt) - R/W
bb. System Outdoor AQ(system_oaq) - R/W
c. Outdoor Air Temp Sensor(oat_fail) - R
dd. Setpoint Adjustment Range(stpt_adj_range) - R/W
e. Enthalpy (BACnet)(oae) - R/W
ff. Optimal Start(optm_start) - R/W
 gg. Compressor Safety Status(comp_status) - R
hh. Continuous Occupied Exhaust(occ_exh) - R/W
ii. DCV Control(dcv_enable) - R/W
jj. Power Exhaust Relay State(pexh) - R
kk. Reversing Valve Output(rev_vlv_type) - R/W
ll. Schedule(schedule) - R/W
mm. Shutdown(shutdown) - R/W
nn. Supply Fan Failure(sfan_fail_alarm) - R
oo. Supply Fan in Hand(sfan_hand_alarm) - R
pp. Supply Fan Runtime(sfan_rntm_alarm) - R
qq. System is shut down(shutdown_status) - R
rr. Unocc Free Cool(ntfc_ena) - R/W
ss. Compressor Stages(comp_stages) - R/W
 tt. Equipment Status(mode_status) - R
uu. Number Of Heat Stages(heat_stages) - R/W
vv. Unit Type(unit_type) - R/W
ww. Economizer Operation(econ_opr) - R
xx. Maximum Heating SAT(sat_ht_max) - R/W
yy. Compressor 2 Runtime(comp2_rntm) - R
zz. Max VFD Output(max_vfd spd) - R/W
aaa. HP Aux Heat Lockout Temp(oat_auxht_lockout) - R/W
bbb. Compressor 1 Runtime(comp1_rntm) - R
ccc. Min VFD Output(min_vfd spd) - R/W
ddd. Fan Off Delay(fan_delay_off) - R/W
eee. Minimum Cooling SAT(sat_cl_min) - R/W
fff. Supply Fan Runtime(sfan_rntm) - R
ggg. Indoor Air Quality CO2 (ppm)(iaq) - R
hhh. Supply Fan VFD(vfd_output) - R
iii. Indoor Air Quality(iaq_alarm) - R
jjj. Supply Air Temperature(sat_alarm) - R
kkk. Space Relative Humidity(sprh_hi_alarm) - R
III. Outdoor Air Quality CO2 (ppm)(oaq) - R

1.7 VAV CONTROL DAMPER AND REHEAT COIL CONTROL

A. Modes of Operation: Occupancy for systems serving zones scheduled through the 25 Live scheduling software shall be overridden by the network scheduling software for HVAC. Each variable air volume (VAV) control damper with a reheat coil zone shall be controlled by a DDC controller using electric actuation. The space served by the VAV terminal unit is controlled in the following modes of operation:

1. Occupied: The VAV damper is controlled within defined maximum and minimum settings. The controller monitors the room temperature sensor and modulates the supply air damper(s) in sequence with the reheat valve to maintain the room temperature at set point. Supply air volume remains at minimum when HW reheat valve is modulated.

2. Unoccupied: The terminal unit is controlled using the night set points. The controller may reset to the occupied mode for a predetermined time period upon a signal from the control system or manually at the room sensor. Manual activation at the room sensor shall enable operation of the AHU.

3. Standby: During normal time-of-day occupancy hours for zones scheduled through the network 25Live scheduling software, when the space is not scheduled for an event, the zone shall enter into Standby mode with independent temperature setpoints.

4. Optimal Start Warm-up Mode: Base the warm-up start time on an optimal start strategy calculated using outdoor air temperature and average zone temperature. If the average zone temperature is less than 69°F (adjustable), initiate the warm-up mode and set the Warm-up Mode Low Temperature Setpoint to 70°F (adjustable). Enable the air handling unit and terminal units for operation. Terminal units shall be operated in heating mode and operate to meet the warm-up mode low temperature setpoint.

5. Demand Shed: Upon receipt of a demand shed signal, all non-critical zones shall reset their heating setpoint down by 4°F and their cooling setpoint up by 4°F. The demand shed mode shall be manually enabled or disabled by an operator button on the graphical user interface as well as by an automatic campus signal.

B. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):

1. System graphic(s) – provide one graphic for each VAV box.
2. Control-damper position(s)
3. Control-valve position.
4. Air temperature sensors.
5. Room temperature and setpoint.
6. All alarms.

1.8 HEATING HOT WATER SYSTEM CONTROL

A. The HHW system will be enabled based on a time-of-day (TOD) schedule and system demand as indicated by HHW valve positions or as programmed by the building operator. System operation shall be allowed at all times. Each HHW pump is served by a variable frequency drive (VFD) to match pump speed to system load.

B. The DDC system shall interface with the boiler control system to enable/disable the boiler, provide temperature setpoint reset signal, and monitor boiler run status and alarms. The boiler shall be controlled by a manufacturer supplied boiler controller. The boiler controller shall control the gas burner assembly to maintain boiler outlet water temperature.

C. Boilers: The boilers shall be operated as follows:

1. The Boiler system shall be staged as follows:
a. Start the integrated boiler pump.
b. Upon proof of pump operation as indicated by the current sensing relay and sufficient HHW flow as indicated by the boiler’s flow switch, enable the boiler’s controller for operation.
c. Appropriate time delays shall be utilized between each step per the boiler manufacturer’s recommended time intervals.

2. The boilers shall be loaded and unloaded on their own internal control programs to maintain the HHW set point. This set point is set by the building operator via the IAS system.

3. Each boiler shall be shut down as follows:
a. Disable the boiler’s control circuit for operation.
b. Stop the lead HHW pump.
c. Appropriate time delays shall be utilized between each step per the boiler manufacturer’s recommended time intervals.

D. HHW Pumps:
1. The HHW pumps are served by variable frequency drives (VFD’s) to match pump speed to system load.
2. HHW pump VFD’s shall modulate to maintain the HHW differential pressure setpoint as sensed by the differential pressure sensors located upstream of building’s HHW pump.
   a. Each building’s differential pressure setpoint shall be unique and determined during the TAB process.
   b. Determine the differential pressure setpoint for each building during the TAB process by finding the lowest pressure that corresponds with the scheduled maximum flow to each hydronic heating coil with all HHW valves 100% open and the pump operating at maximum speed.
3. The minimum VFD speed shall be that which produces the minimum allowable flow through the pump per the pump manufacturer’s recommendations (exact speed to be determined during test and balance).
4. A failure of the lead HHW pump shall cause the lag pump to start and an alarm condition shall be indicated at the building operator’s terminal.

E. Heating Hot Water Supply (HHWS) Temperature Control: The DDC System shall reset the HHWS temperature setpoint according to outside temperature.
1. Reset Schedule: Control HHWS temperature in straight-line relationship for the following conditions (all setpoints adjustable):
   a. 180 degrees F heating water when outside temperature is at or below 55 degrees F.
   b. 160 degrees F heating water when outside temperature is at or above 70 degrees F.

F. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):
1. System graphic(s).
2. Outside temperature.
3. Lead Boiler and HHW pump designation.
5. Boiler run status (gas firing).
7. HHW pump on-off indication, run status, alarm, and speed (Hz and percentage) for each pump.
8. HHW temperatures as indicated on the drawings.
9. HHWS temperature set point.
10. Lifetime runtime of boilers and pumps
11. Staging runtime of boilers and pumps
12. Boiler Modbus points to display in the main Boiler system graphic:
   a. System Supply Temperature – r
   b. Temperature Setpoint Target – r/w
   c. Boiler On/Off – r/w
   d. Boiler 1 Outlet Temperature – r
   e. Boiler 1 Inlet Temperature – r
   f. Boiler 1 Vent Temperature – r
   g. Boiler 1 High Limit Temperature – r
   h. Boiler 1 Mod Rate – r
   i. Boiler 1 Ignition Status - r
   j. Boiler 1 Pump – r
   k. Boiler 1 Status Register Flow Switch- r
   l. Boiler Error - r

13. Boiler Modbus points to display in a drill down table accessible through a link in the Boiler system graphic:
   a. System Pump Runtime - r
   b. Boiler 1 Runtime – r
   c. Boiler 1 Cycles – r
   d. Boiler 1 Pump Runtime – r
   e. Boiler 1 Error Code – r
   f. Boiler Pump Control Mode r/w
   g. Target Temperature Differential – r/w
   h. Target Mod Rate – r/w
   i. All alarms (display plain English text description for multistate alarms)

14. VFD LAN points for each VFD (minimum requirements):
   a. VFD run status
   b. Fault status
   c. Bypass status
   d. Frequency (Hz)
   e. RPM
   f. Current (amps)
   g. Power (kW)
   h. DC bus voltage
   i. Output voltage
   j. VFD temperature
   k. Run time (hours and thousands of hours)

15. VFD Modbus points to display in the main Boiler system graphic:
   a. Actual Speed - r
   b. Motor Input Power - r
   c. HOA Status -r/w
   d. BMS Set Speed – w/r
   e. Actual Speed – r
   f. Motor Input Voltage – r
   g. Motor Input Current – r
   h. Total Pump Running Hours – r
   i. Trip Pump Running Hours – r
   j. Control Mode – r
   k. Minimum Speed Limit – r/w
   l. Maximum Speed Limit – r/w

1.9 EXHAUST FANS

A. Provide DDC control using electric actuation.
B. The exhaust fan shall be logically interlocked to run when its associated packaged unit is enabled.

C. Safety:
   1. The DDC system shall use a current sensing relay to monitor the fan status.

D. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):
   1. System graphic(s).
   2. Exhaust fan on-off indication, run status, and alarms.

1.10 TRENDING
A. Provide trend collection on all DDC points specified. Establish trend collection intervals of 15 minutes for specified points. Provide trend data collection capacity to store up to 365 days worth of data for all specified points.

1.11 DUCTLESS SPLIT SYSTEM HEAT PUMPS
A. BACnet communicating thermostat shall communicate to the unit controllers through a Carrier 24v relay interface. Thermostat shall be adjustable locally or remotely from the IAS.

B. Safety:
   1. The DDC system shall use a current sensing relay to monitor the unit status at the outdoor unit.

C. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):
   1. System graphic(s).
   2. Unit on-off indication.
   3. Indoor Fan Speed – r/w
   4. Operating Mode - r/w
   5. Zone Temperature - r
   6. System Error – r

D. Trending
   1. Provide trend collection on all physical DDC points specified. Establish trend collection intervals of 15 minutes for specified points. Provide trend data collection capacity to store up to 365 days worth of data for all specified points.

1.12 STUDENT GATHERING ZONE CONTROL
A. The variable air volume (VAV) control damper within a reheat coil zone shall be controlled by a DDC controller using electric actuation. The space served by the VAV terminal unit is controlled in Occupied, Unoccupied, and Natural Ventilation modes as follows:
   1. Occupied: The VAV damper is controlled within defined maximum and minimum settings. The controller monitors the room temperature sensor and modulates the supply air damper(s) in sequence with the reheat valve to maintain the room temperature at set point. Supply air volume remains at minimum when HW reheat valve is modulated.
   2. Unoccupied: The terminal unit is controlled using the night set points. The controller may reset to the occupied mode for a predetermined time period upon a signal from the control system or manually at the room sensor. Manual activation at the room sensor shall enable operation of the AHU.
   3. Natural Ventilation: Upon proof of the bay door being opened as sensed by a dry contact input to the building automation system controller for a period of 3 minutes (adjustable),
the BMS shall disable the zonal controller reheat coil and command the supply airflow damper closed.

B. HVLS Fan Control:
1. The fan will operate through a manufacturer supplied wall controller. The wall controller shall allow the occupant to locally enable, disable, set fan speed/rotation, and enable fan control mode to maintain the room temperature at setpoint based on a manufacturer supplied temperature sensor.
2. The DDC system shall interface with the HVLS control system to enable/disable the fan through a DDC relay to disconnect power. The relay shall enable the fan based on a time-of-day (TOD) schedule as programmed by the building operator.

C. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):
1. System graphic(s).
2. Bay Door Status
3. Zone Controller Occupancy Status
4. Zone Controller Reheat Coil
5. Zone Controller Damper Position
6. Fan Enable

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION
ARTICLE 1  SUMMARY

1.1 This Division of the specification outlines the provisions of the contract work to be performed under this Division.

1.2 This Section applies to and forms a part of each section of specifications in Division 26 and all work performed under Division 26, 27 and 28.

1.3 In addition, work in this Division is governed by the provisions of the bidding requirements, contract forms, general conditions and all sections under general requirements.

1.4 These specifications contain statements which may be more definitive or more restrictive than those contained in the General Conditions. Where these statements occur, they shall take precedence over the General Conditions.

1.5 Where the words 'provide' or 'provision' are used, it shall be definitely interpreted as 'furnishing and installing complete in operating condition'. Where the words 'as indicated' or 'as shown' are used, it shall mean as shown on contract drawings.

1.6 Where items are specified in the singular, this Division shall provide the quantity as shown on drawings plus any spares or extras mentioned on drawings or specifications. All specified and supplied equipment shall be new.

ARTICLE 2  CONTRACTOR QUALIFICATIONS

2.1 The Contractor shall have a current California C-10 Electrical Contractor's license and all individuals working on this project shall have passed the Department of Industrial Relations Division of apprenticeship Standards – "Electrician Certification Program."

ARTICLE 3  CODES, PERMITS AND FEES

3.1 Comply with all applicable laws, ordinances, rules, regulations, codes, or rulings of governmental units having jurisdiction as well as standards of NFPA, and serving utility requirements.

3.2 Obtain permits, fees, inspections, meter and the like, associated with work in each section of this Division.

3.3 Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Act (OSHA).

ARTICLE 4  EXAMINATION OF PREMISES

4.1 Examine the construction drawings and premises prior to bidding. No allowances will be made for not being knowledgeable of existing conditions.

ARTICLE 5  STANDARDS

5.1 The following standard publications of the latest editions enforced, and supplements thereto shall form a part of these specifications. All electrical work must, as a minimum, be in accordance with these standards.
ARTICLE 6 DEFINITIONS

6.1 Concealed: Hidden from sight, as in trenches, chases, hollow construction, or above furred spaces, hung ceilings - acoustical or plastic type, or exposed to view only in tunnels, attics, shafts, crawl spaces, unfinished spaces, or other areas solely for maintenance and repair.

6.2 Exposed, Non-Concealed, Unfinished Space: A room or space that is ordinarily accessible only to building maintenance personnel, a room noted on the 'finish schedule' with exposed and unpainted construction for walls, floors, or ceilings or specifically mentioned as 'unfinished'.

6.3 Finish Space: Any space ordinarily visible, including exterior areas.

ARTICLE 7 WORK AND MATERIALS

7.1 Unless otherwise specified, all materials must be new and of the best quality. Materials previously incorporated into other projects, salvaged, or refurbished are not considered new. Perform all labor in a thorough and workmanlike manner.

7.2 All materials provided under the contract must bear the UL label where normally available. Note that this requirement may be repeated under equipment specifications. In general, such devices as will void the label should be provided in separate enclosures and wired to the labeled unit in proper manner.

ARTICLE 8 SHOP DRAWINGS AND SUBMITTALS

8.1 Submit shop drawings and all data in accordance with Division 1 of these specifications and as noted below for all equipment provided under this Division.

8.2 Shop drawings submittals demonstrate to the Architect that the Contractor understands the design concept. The Contractor demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods of material and equipment he intends to use. If deviations, discrepancies, or conflicts between submittals and specifications are discovered either prior to or after submittals are processed, notify the Architect immediately.

8.3 Manufacturer’s data and dimension sheets shall be submitted giving all pertinent physical and engineering data including weights, cross sections and maintenance instructions.
Standard items of equipment such as receptacles, switches, plates, etc., which are cataloged items, shall be listed by manufacturer.

8.4 Index all submittals and reference them to these specifications. All submittal items shall be assembled and submitted, one for each specification section. (Multiple specification sections may be grouped together in one common submittal binder, as long as each individual section is clearly identified.) Partial or incomplete submittal sections will not be reviewed.

ARTICLE 9   EQUIPMENT PURCHASES

9.1 Arrange for purchase and delivery of all materials and equipment within 20 days after approval of submittals. All materials and equipment must be ordered in ample quantities for delivery at the proper time. If items are not on the project in time to expedite completion, the Owner may purchase said equipment and materials and deduct the cost from the contract sum.

9.2 Provide all materials of similar class or service by one manufacturer.

ARTICLE 10   COOPERATIVE WORK

10.1 Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration.

10.2 Cooperative work includes: General supervision and responsibility for proper location and size of work related to this Division, but provided under the other sections of these specifications, and installation of sleeves, inserts, and anchor bolts for work under each section in this Division.

ARTICLE 11   VERIFICATION OF DIMENSIONS

11.1 Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions, etc., and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.

11.2 Drawings are essentially diagrammatic, and many offsets, bends, pull boxes, special fittings, and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact location, routes, building obstructions, etc. and install apparatus and equipment in manner and locations to avoid obstructions, preserve headroom, keep openings and passageways clear, and maintain proper clearances.

ARTICLE 12   CUTTING AND PATCHING

12.1 All cutting, and patching shall be in accordance with Division 1 of these specifications and as noted below.

12.2 Cut existing work and patch as necessary to properly install new work. As the work progresses, leave necessary openings, holes, chases, etc., in their correct location. If the required openings, holes, chases, etc., are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members including wall framing without the consent of the Architect.

ARTICLE 13   CLOSING-IN OF UNINSPECTED WORK

13.1 Cover no work until inspected, tested, and approved by the Architect. Where work is covered before inspection and test, uncover it and when inspected, tested, and approved, restore all work to original proper condition at no additional cost to Owner.
ARTICLE 14 EXCAVATION AND BACKFILL

14.1 All excavation and backfill shall be in accordance with Division 1 of these specifications and as noted below.

14.2 Perform all necessary excavation, shoring, and backfilling required for the proper laying of all conduits inside the building and premises, and outside as may be necessary.

14.3 Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms no wider than necessary to provide ample work room. Grade trench bottoms accurately. Machine grade only to the top line of the conduits, doing the remainder by hand. Do not cut any trench near or under footings without first consulting the Architect. All trenches shall be done in accordance with OSHA standards and regulations.

14.4 Backfilling shall be done with each layer compacted before another layer is added. No stones or coarse lumps shall be laid directly on a conduit or conduits.

14.5 Trenches shall be filled with the specified material. Sod, if any, shall be removed in cut sections and replaced in same manners.

14.6 Provide pumps and drainage of all open trenches for purposes of installing electrical duct and wiring.

14.7 Perform all backfilling in accordance with the requirements of and under the direction of the Geotechnical Engineer.

14.8 Where new underground trenching is required on sites or in any area where existing underground utilities exist, the Contractor shall provide an independent professional utility locating service to locate exact vertical and horizontal locations of all existing utilities. Where existing utilities are found the Contractor shall hand dig those areas to avoid disruption. The Contractor shall be responsible for immediate repairs to existing underground utilities damaged during construction. The Contractor shall repair all existing asphalt, concrete and landscape surfaces damaged or removed during construction to match their original conditions. Where trenching extends through public streets or roadways, the Contractor shall notify underground service alert in addition to the independent locating service 48 hours before start of construction to determine location of existing utilities by calling (800) 422-4133.

ARTICLE 15 CONCRETE

15.1 Where used for structures to be provided under the contract such as bases, etc., concrete work, and associated reinforcing shall be as specified under Division 3 of these specifications.

15.2 See other sections for additional requirements for underground vaults, cable ducts, etc.

ARTICLE 16 ACCESSIBILITY

16.1 Install all control devices or other specialties requiring reading, adjustment, inspection, repairs, removal, or replacement conveniently and accessibly throughout the finished building.

16.2 All required access doors or panels in walls and ceilings are to be furnished and installed as part of the work under this Section. Refer to Division 1 of these specifications and as noted below.
16.3 Where located in fire rated assemblies, provide doors which match the rating of the assembly and are approved by the jurisdictional authority.

16.4 Refer to ‘finish schedule’ for types of walls and ceilings in each area and the architectural drawings for rated wall construction.

16.5 Coordinate work of the various sections to locate specialties requiring accessibility with others to avoid unnecessary duplication of access doors.

ARTICLE 17  FLAShING

17.1 Flash and counter flash all conduits penetrating roofing membrane as shown on Architectural drawings. All work shall be in accordance with Division 7 of these specifications.

ARTICLE 18  IDENTIFICATION OF EQUIPMENT

18.1 All electrical equipment shall be labeled, tagged, stamped, or otherwise identified in accordance with the following schedules:

18.1.1 General:

18.1.1.1 In general, the installed laminated nameplates as hereinafter called for shall also clearly indicate its use, areas served, circuit identification, voltage and any other useful data.

18.1.1.2 All auxiliary systems, including communications, shall be labeled to indicate function.

18.1.2 Lighting and Local Panelboards:

18.1.2.1 Panel identification shall be with white and black micarta nameplates. Letters shall be no less than 3/8" high.

18.1.2.2 Circuit directory shall be two column typewritten card set under glass or glass equivalent. Each circuit shall be identified by the room number and/or number of unit and other pertinent data as required.

18.1.3 Distribution Switchboards and Feeders Sections:

18.1.3.1 Identification shall be with 1" x 4" laminated white micarta nameplates with black lettering on each major component, each with name and/or number of unit and other pertinent data as required. Letters shall be no less than 3/8" high.

18.1.3.2 Circuit breakers and switches shall be identified by number and name with 3/8" x 1-1/2" laminated micarta nameplates with 3/16" high letters mounted adjacent to or on circuit breaker or switch.

18.1.4 Disconnect Switches, Motor Starters and Transformers:

18.1.4.1 Identification shall be with white micarta laminated labels and 3/8" high black lettering.

18.1.5 All communication system terminal boxes including T.V., telephone/intercom, security, fire alarm, clock, and computer networking shall be provided with white micarta laminated labels and 3/8" high black lettering.
ARTICLE 19 CONSTRUCTION FACILITIES

19.1 Furnish and maintain from the beginning to the completion all lawful and necessary guards, railings, fences, canopies, lights, warning signs, etc. Take all necessary precautions required by City, State Laws, and OSHA to avoid injury or damage to any persons and property.

19.2 Temporary power and lighting for construction purposes shall be provided under this Section. All work shall be in accordance with Division 1 of these specifications.

ARTICLE 20 GUARANTEE

20.1 Guarantee all material, equipment and workmanship for all sections under this Division in writing to be free from defect of material and workmanship for one year from date of final acceptance, as outlined in the general conditions. Replace without charge any material or equipment proven defective during this period. The guarantee shall include performance of equipment under all site conditions, conditions of load, installing any additional items of control and/or protective devices, as required.

ARTICLE 21 PATENTS

21.1 Refer to the General Conditions for Contractor's responsibilities regarding patents.

ARTICLE 22 PLUMBING (DIVISION 22) / HEATING, VENTILATING, AND AIR CONDITIONING (DIVISION 23) / ELECTRICAL – COORDINATION REQUIREMENTS

22.1 All electrical work performed for this project shall conform to the California Electrical Code, to Local Building Codes and in conformance with Division 22, 23, and 26 of these specifications, whether the work is provided under the “Plumbing”, “Heating, Ventilating, and Air Conditioning”, or the “Electrical” Division of these specifications. Where the Division 22 and/or Division 23 Contractor is required to provide electrical work, he shall arrange for the work to be done by a licensed Division 26 Contractor, using qualified electricians. The Division 22 and/or Division 23 Contractor shall be solely and completely responsible for the correct functioning of all equipment regardless of who provided the electrical work.

22.2 The work under Division 22 and/or Division 23 shall include the following:

22.2.1 All motors required by mechanical equipment.

22.2.2 All starters for mechanical equipment which are not provided under the electrical division as part of a motor control center or otherwise indicated on the electrical drawings.

22.2.3 All wiring interior to packaged equipment furnished as an integral part of the equipment.

22.2.4 All control wiring and conduit for mechanical control systems.

22.2.5 All control systems required by mechanical equipment.

22.3 The work under Division 26 shall include the following:

22.3.1 All power wiring and conduit; and conduit only for EMS control conductors between each building and the main control panel.

22.3.2 Electrical disconnects as shown on the electrical drawings.
22.3.3 Starters forming part of a motor control center.

22.4 All power wiring and conduit to equipment furnished under Division 22 and/or Division 23 shall be provided under Division 26. Control wiring and conduit, whether line voltage or low voltage, shall be provided under the division which furnishes the equipment.

22.5 Power wiring shall be defined as all wiring between the panelboard switchboard overcurrent device, motor control center starter or switch, and the safety disconnect switch or control panel serving the equipment. Also, the power wiring between safety disconnect switch and the equipment line terminals.

22.6 Control wiring shall be defined as all wiring, either line voltage or low voltage, required for the control and interlocking of equipment, including but not limited to wiring to motor control stations, solenoid valves, pressure switches, limit switches, flow switches, thermostats, humidistats, safety devices, smoke detectors, and other components required for the proper operation of the equipment.

22.7 All motor starters which are not part of motor control centers and which are required for equipment furnished under this Division shall be furnished and installed by the Division furnishing the equipment and power wiring connected under Division 26. Motor starters and control devices in motor control centers shall be furnished and installed under Division 26.

22.8 Division 26 Contractor shall make all final connections of power wiring to equipment furnished under this Division.

22.9 Wiring diagrams complete with all connection details shall be furnished under each respective Section.

22.10 Motor starters supplied by Plumbing and/or Heating, Ventilating and Air Conditioning shall be fused combination type minimum NEMA Size 1, and conform to appropriate NEMA standards for the service required. Provide NEMA type 3R/12 gasketed enclosures in wet locations. Provide all starters with appropriately sized overload protection and heater strips provided in each phase, hand/off auto switches, a minimum of 2 NO and NC auxiliary contacts as required, and an integral disconnecting means. For ½ horsepower motors and below, when control requirements do not dictate the use of a starter, a manual motor starter switch with overload protection in each phase may be provided. Acceptable manufacturers are Allen Bradley, General Electric, Square D, Furnas and Cutler Hammer.

ARTICLE 23 EQUIPMENT ROUGH-IN

23.1 Rough-in all equipment, fixtures, etc. as designed on the drawings and as specified herein. The drawings indicate only the approximate location of rough-ins. Mounting heights of all switches, receptacles, wall mounted fixtures and such equipment must be coordinated with the Architectural Designs. The Contractor shall obtain all rough-in information before progressing with any work for rough-in connections. Minor changes in the contract drawings shall be anticipated and provided for under this Division of the specifications to comply with rough-in requirements.

ARTICLE 24 OWNER FURNISHED AND OTHER EQUIPMENT

24.1 Rough-in and make final connections to all Owner furnished equipment shown on the drawings and specified, and all equipment furnished under other sections of the specifications.

ARTICLE 25 EQUIPMENT FINAL CONNECTIONS

25.1 Provide all final connections for the following:
25.1.1 All equipment furnished under this Division.

25.1.2 Electrical equipment furnished under other sections of the specification.

25.1.3 Owner furnished equipment as specified under this Division.

ARTICLE 26 INSERTS, ANCHORS, AND MOUNTING SLEEVES

26.1 Inserts and anchors must be:

26.1.1 Furnished and installed for support of work under this Division.

26.1.2 Mounting of equipment that is of such size as to be free standing and that equipment which cannot conveniently be located on walls, such as motor starters, etc., shall be rigidly supported on a framework of galvanized steel angle of Unistrut or B-line systems with all unfinished edges painted.

26.1.3 Furnish and install all sleeves as required for the installation of all work under all Sections of this Division and for all communication systems including any communication systems described in this Section which are bid to the General Contractor. Sleeves through floors, roof, and walls shall be as described in “Conduit and Fittings” Section 26 05 33.

ARTICLE 27 SEISMIC ANCHORING

27.1 All switchgear and other free-standing electrical equipment or enclosures shall be anchored to the floor and braced at the top of the equipment to the structure. The Contractor shall submit drawings signed by the Contractors registered structural Engineer indicating method of compliance prior installation.

27.2 All sound systems, communication, signal or data networking equipment or enclosures shall be anchored to the structure. The Contractor shall submit drawings signed by the Contractors registered Structural Engineer indicating method of compliance prior to installation.

ARTICLE 28 RUST PROOFING

28.1 Rust proofing must be applied to all ferrous metals and shall be in accordance with Section 05500 of these specifications and as noted below.

28.1.1 Hot-dipped galvanized shall be applied and after forming of angle-iron, bolts, anchors, etc.

28.1.2 Hot-dipped galvanized coating shall be applied after fabrication for junction boxes and pull boxes cast in concrete.

ARTICLE 29 GENERAL WIRING

29.1 Where located adjacent in walls, outlet boxes shall not be placed back to back, nor shall extension rings be used in place of double boxes, all to limit sound transmission between rooms. Provide short horizontal nipple between adjacent outlet boxes, which shall have depth sufficient to maintain wall coverage in rear by masonry wall.

29.2 In those instances where outlet boxes, recessed terminal boxes, or recessed equipment enclosures are installed in a fire rated assembly, provide “Flamesafe FSD 1077” fire stopping pads or approved equal, over the outlet or box.
29.3 Complete rough-in requirements of all equipment to be wired under the contract are not indicated. Coordinate with respective trades furnishing equipment or with the Architect as the case may be for complete and accurate requirements to result in a neat, workmanlike installation.

ARTICLE 30 SEPARATE CONDUIT SYSTEMS

30.1 Each electrical and signal system shall be contained in a separate conduit system as shown on the drawings and as specified herein. This includes each power system, each lighting system, each signal system of whatever nature, telephone, standby system, sound system, control system, fire alarm system, etc.

30.2 Further, each item of building equipment must have its own run of power wiring. Control wiring may be included in properly sized conduit for equipment feeders of #6 AWG and smaller, having separate conduit for larger sizes.

ARTICLE 31 CLEANUP

31.1 In addition to cleanup specified under other sections, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any spattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.

31.2 Use steel brushes on exposed metal work to carefully remove rust, etc., and leave smooth and clean.

31.3 During the progress of the work, keep the premises clean and free of debris.

ARTICLE 32 UTILITY SERVICES

32.1 The Division 26 Contractor shall contact the serving utility companies; notify the serving power, telephone and cable TV utilities of the following:

32.1.1 Name and address of Contractor.

32.1.2 Estimated times of construction start, completion and required service connections.

32.1.3 Project service voltage, phase load, and service size.

32.1.4 Provide to the Architect written verification from each utility company indicating their concurrence with the contract documents.

32.2 Contractor shall notify underground service alert 48 hours before start of construction to determine location of existing utilities by calling (800) 422-4133. All work shall be in accordance with the Division 1 Sections of these specifications.

32.3 All utility company requirements shall be complied with and approval shall be obtained from the utility company for service equipment. Such as, verification of a field test of the ground fault protection on the main service equipment, panic hardware and etc.

ARTICLE 33 TEST AND INSPECTION PROCEDURES – EXISTING MEDIUM VOLTAGE, AIR INSULATED, CIRCUIT BREAKER TESTS

33.1 Tests shall be done in accordance with ANSI/NEMA Standards and by a contractor certified in medium voltage testing and procedures. Contractor qualifications shall be submitted to the electrical engineer of record for approval.
33.2 Testing shall not be done or scheduled until the outage is scheduled and approved by the owner. Outage shall not exceed 24 hours unless approved by the owner and coordinated with the CM and Architect of Record.

33.3 Visual and Mechanical Inspection

33.3.1 Inspect physical and mechanical condition.

33.3.2 Inspect anchorage, alignment, and grounding.

33.3.3 Verify that all maintenance devices are available for servicing and operating the breaker.

33.3.4 Clean the Unit.

33.3.5 Inspect arc chutes.

33.3.6 Inspect moving and stationary contacts for condition, wear, and alignment.

33.3.7 Close/open breaker and check for binding, friction, contact alignment, contact sequence, and penetration.

33.3.8 Perform all mechanical operation tests on the operating mechanism in accordance with manufacturer’s published data.

33.3.9 Inspect bolted electrical connections for high resistance using one of the following methods:

33.3.9.1 Use of a low-resistance ohmmeter in accordance with Section 33.4.

33.3.9.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.

33.3.9.3 Perform a thermographic survey in accordance with NETA standards.

33.3.10 Verify cell fit and element alignment.

33.3.11 Verify racking mechanism operation.

33.3.12 Inspect puffer operation.

33.3.13 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

33.3.14 Record as-found and as-left operation-counter readings.

33.4 Electrical Tests

33.4.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable. See Section 33.3.

33.4.2 Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer’s published data.
33.4.3 Perform a contact/pole-resistance test.

33.4.4 With the breaker in a test position, perform the following tests:

33.4.4.1 Trip and close breaker with the control switch.

33.4.4.2 Trip breaker by operating each of its protective relays. Recalibrate and adjust relay settings based on time current study to be done for the project.

33.4.4.3 Verify mechanism charge, trip-free, and antipump functions.

33.4.4.4 Verify blowout coil circuit continuity.

33.4.4.5 Verify operation of heaters, if applicable.

33.4.4.6 Test instrument transformers in accordance with NETA standards.

33.5 Test Values

33.5.1 Test Values – Visual and Mechanical

33.5.1.1 Bolt-torque levels should be in accordance with manufacturer’s published data.

33.5.1.2 Results of the thermographic survey shall be in accordance with NETA standards.

33.5.1.3 Compare travel and velocity values to manufacturer’s published data.

33.5.2 Test Values – Electrical

33.5.2.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

33.5.2.2 Circuit breaker insulation resistance should be in accordance with manufacturer’s published standards.

33.5.2.3 Insulation-resistance values of circuit breakers should be in accordance with manufacturer’s published data. Values of insulation resistance less than manufacturer’s recommendations should be investigated.

33.5.2.4 Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer’s published data. If manufacturer’s data is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

33.5.2.5 Breaker mechanism charge, close, open, trip, trip-free, and antipump features shall function as designed.

33.5.2.6 Minimum pickup for trip and close coils shall be in accordance with manufacturer’s published data.
33.5.2.7 Power-factor or dissipation-factor and capacitance values should be within ten percent of nameplate rating for bushings. Hot collar tests are evaluated on a milliampere/milliwatt loss basis, and the results should be compared to values of similar bushings.

33.5.2.8 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the over potential test, the circuit breaker is considered to have passed the test.

33.5.2.9 The blowout coil circuit should exhibit continuity.

33.5.2.10 Heaters should be operational.

33.5.2.11 The results of instrument transformer tests shall be in accordance with manufacturer’s standards.

ARTICLE 34 PAINTING

34.1 Paint all unfinished metal as required in accordance with Division 1 of these specifications. (Galvanized and factory painted equipment shall be considered as having a sub-base finish.)

ARTICLE 35 GENERAL DEMOLITION REQUIREMENTS

35.1 Remove existing work and items which are required to be removed in such manner that minimum damage and disturbance is caused to adjacent and connection work scheduled to remain. Repair or replace existing work schedule.

35.2 Include preparation of existing areas to receive new materials and removal of materials and equipment to alter or repair the existing building as indicated and as specified.

35.3 Perform demolition exercising proper care to prevent injury to the public, workmen and adjoining property.

35.4 Perform the removal, cutting, drilling of existing work with extreme care and use small tools in order not to jeopardize the structural integrity of the building.

35.5 Rebuild to existing condition or better, existing work which has to be removed to allow the installation of new work as required.

35.6 Remove, protect and reinstall existing items as indicated. Replace materials scheduled for reuse which are damaged by the Contractor to the extent that they cannot be reused, with equal quality material, and installation.

35.7 Do not reuse in this project materials and items removed from existing site or building, except with specific written approval by the Architect in each case, unless such removed material or item is specifically indicated or specified to be reused.

35.8 Remove materials and equipment indicated to be salvaged for reinstallation and store to prevent damage and reinstall as the work progresses. Do not reuse in this project, other materials and equipment removed from existing site or building, except with specific written approval by the Architect in each case.

35.9 Patch areas requiring patching, including damage caused by removing, relocating or adding fixtures and equipment, damages caused by demolition at adjacent materials.

35.10 Do not stockpile debris in the existing building, without the approval of the Architect. Remove debris as it accumulates from removal operations to a legal disposal area.
35.11 Contractor to assume existing oil filled and dry transformers, oil switches, ballasts, lamps, wooden poles, cross arms, computers, computer monitors, and conductor insulation containing materials considered hazardous. Comply with local, state and federal regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution. Contractor shall be responsible for removal of the above hazardous materials where encountered. Include all costs for such removal as part of this contract.

35.12 All fluorescent, compact fluorescent, high intensity discharge, metal halide, mercury vapor, high and low-pressure sodium, and neon lamps are to be disposed of as required by the California Waste Rule Regulations as described in the California Code of Regulations, Title 22, Division 4.5 and Chapter 23.

35.13 **Communication System:** Where new communication systems, (including telephone, intercom, clock, security, fire alarm, data, multimedia, CATV or lighting controls) are installed to replace existing systems, unless otherwise directed the existing systems shall remain fully operational until the new system has been installed and tested. Demolition of the existing systems shall include removal of all equipment and associated wiring and exposed conduits and providing new blank covers for all abandoned device locations.

35.14 **Salvage Power Equipment:** The Contractor shall carefully remove all existing switchboards, panelboards, transformers, and confirm in writing which items the Owner wishes to keep. These items shall be transported to the Owner’s maintenance facilities by the Contractor. All remaining items shall be disposed of by the Contractor.

35.15 **Salvage Lighting Equipment:** The Contractor shall confirm in writing which items the Owner wishes to keep. These items shall be transported to the Owner’s maintenance facilities by the Contractor. All remaining items shall be disposed of by the Contractor.

35.16 **Salvage Communication Equipment:** The Contractor shall carefully remove all communication devices (telephone, intercom, clock, security, fire alarm, data, multimedia, CATV or lighting controls) and box each type of devices separately. The Contractor shall deliver all items to the Owner’s maintenance facility.

**ARTICLE 36 PROJECT CLOSEOUT**

36.1 Prior to completion of project, compile a complete equipment maintenance manual for all equipment supplied under sections of this Division, in accordance with Division 1 of these specifications and as described below.

36.2 Equipment Lists and Maintenance Manuals:

36.2.1 Prior to completion of job, Contractor shall compile a complete equipment list and maintenance manuals. The equipment list shall include the following items for every piece of material equipment supplied under this Section of the specifications:

36.2.1.1 Name, model, and manufacturer.

36.2.1.2 Complete parts drawings and lists.

36.2.1.3 Local supply for parts and replacement and telephone number.
36.2.1.4 All tags, inspection slips, instruction packages, etc., removed from equipment as shipped from the factory, properly identified as to the piece of equipment it was taken from.

36.3 Maintenance manuals shall be furnished for each applicable section of the specifications and shall be suitably bound with hard covers and shall include all available manufacturers’ operating and maintenance instructions, together with “as-built” drawings to properly operate and maintain the equipment. The equipment lists and maintenance manuals shall be submitted in duplicate to the Architect for approval not less than 10 days prior to the completion of the job. The maintenance manuals shall also include the name, address, and phone numbers of all subcontractors involved in any of the work specified herein. Four copies of the maintenance manuals bound in single volumes shall be provided.

ARTICLE 37 RECORD DRAWINGS

37.1 The Division 26 Contractor shall maintain record drawings as specified in accordance with Division 1 of these specifications, and as noted below.

37.2 Drawings shall show locations of all concealed underground conduit runs, giving the number and size of conduit and wires. Underground ducts shall be shown with cross section elevations and shall be dimensioned in relation to permanent structures to indicate their exact location. Drawing changes shall not be identified only with referencing CORs and RFIs, the drawings shall reflect all of the actual additions or changes made. All as-built drawing information shall be prepared by the contractor in AutoCAD, updating the contract computer files as needed to reflect actual installed conditions for all site plans, lighting, power, communication, networking, audio visual, security or fire alarms systems included in the scope of work for this project.

37.3 One set of these record drawings shall be delivered to the Architect. The engineer will review documents for completeness and will not be responsible for editing contractor computer files.

ARTICLE 38 CHANGES AND EXTRA WORK

38.1 When changes in work are requested, the Division 26 Contractor shall provide unit prices for the work involved in accordance with Division 1 of these specifications, and the following:

38.1.1 The material Costs shall not exceed the latest edition of the “Trade Service” end column “C” price list. The materials prices may be higher only where the Contractor can produce invoices to substantiate higher material costs. The Contractor shall submit a print out copy of the trade service sheets with the change order to substantiate these values.

38.1.2 The labor Costs shall not exceed the latest edition of the “NECA Manual of Labor Units” normal column.

38.2 When credits in work are requested, the Division 26 Contractor shall provide unit prices for the work involved in accordance with Division 1 of these specifications, and the following:

38.2.1 The Material Costs shall not be less than 80% of the latest edition of the “Trade Service” end column price list. The materials prices may be lower only where the Contractor can produce invoices to substantiate lower material costs. Restocking fees may also be included in this amount where applicable.
38.2.2 The Labor Costs shall **not be less than 80% of** the latest edition of the "NECA Manual of Labor Units" normal column.

38.3 Conduit pricing for conduits of all types sized 3” or smaller.

When changes in the scope of work require the Contractor to estimate conduit installations, they shall **NOT include labor values (only material cost may be included)** for any of the below items. The labor values for conduit installation represented in the NECA manual are inflated to a point where additional labor for the below items can not be justified.

38.3.1 Couplings.

38.3.2 Set Screw or Compression Fittings, locknuts, Bushings and washers.

38.3.3 Conduit straps and associated screws or nails.

38.3.4 LB fittings or other specialty fittings or specialty mounting hardware may be included where needed.

38.4 Wire pricing for all types and sizes.

When changes in the scope of work require the Contractor to estimate wire installations they shall **NOT include labor values (only material cost may be included)** for any of the below items. The labor values for wire installation represented in the NECA manual are inflated to a point where additional labor for the below items can not be justified.

38.4.1 Locknuts, Bushings, tape, wire markers.

38.5 When changes in the scope of work require other equipment installations such as lighting fixtures, panelboards, switchboards, wiring devices, communications equipment etc. the Contractor shall **NOT include labor values (only material cost may be included)** for any of the below items. The labor values for these equipment items represented in the NECA manual are inflated to a point where additional labor for the below items can not be justified.

38.5.1 Associated screws, nails, bolts, anchors or supports.

38.5.2 Locknuts, washers, tape.

38.6 The total labor hours for extra work will be required to be calculated as follows:

38.6.1 Change orders with 1 to 30 total labor hours

- General Laborer 10% of total labor hours
- Journeyman 10% of total labor hours
- Foreman 80% of total labor hours

38.6.2 Change orders with 31 to 100 total labor hours

- General Laborer 20% of total labor hours
- Journeyman 40% of total labor hours
- Foreman 40% of total labor hours

38.6.3 Change orders with over 100 total labor hours

- General Laborer 30% of total labor hours
- Journeyman 50% of total labor hours
Foreman 20% of total labor hours

38.7 When change orders are issued which allow the work to be completed in the normal sequence of construction, the labor rates shall be based on the most current “Prevailing Wage” – straight time total hourly rate. When change orders require the Contractor to work out of sequence the “Prevailing Wage” – daily overtime hourly rate shall apply. Special condition situations shall be reviewed on an individual basis for alternate hourly rate schedules.

38.8 Costs will not be permitted for additional supervision on site or office time for processing any change order other than the 10% overhead allowance as described in Division 1. Cost for special equipment required to install items for an individual change order are permitted and must be individually identified. Lump Sum cost for small tools or any other cost not specifically required for the change order are not permitted.

38.9 Contractor estimates shall be formatted to clearly identify each of the following:

38.9.1 Line item description of each type of material or labor item.

38.9.2 Description of quantity for each item.

38.9.3 Description of (material cost per / quantity).

38.9.4 Description of (labor cost per / quantity).

38.9.5 Description of total labor hour breakdown per Foreman, Journeyman or General Laborer as described above.

ARTICLE 39 ELECTRONIC FILES

39.1 The Contractor shall make a written request directly to Johnson Consulting Engineers for electronic drawing files. As a part of the written request, please include the following information:

39.1.1 Clearly indicate each drawing sheet needed (i.e., E1.1, E2.1, etc.).

39.1.2 Identify the name, phone number, mailing address and e-mail address of the person to receive the files.

39.1.3 Provide written confirmation and agreement with the requirements described for payment of computer files, as described below.

39.2 Detail or riser diagram sheets, or any other drawings other than floor plans or site plans, will not be made available to the Contractor.

39.3 Files will only be provided in the AutoCAD format in which they were created.

39.4 Requests for files will be processed as soon as possible; a minimum of 7 working days should be the normal processing time. The Contractor shall be completely responsible for requesting the files in time for their use.

39.5 CAD files will be made available via e-mail or on disk, depending on the quantity of files requested. The Contractor requesting the files will be required to pay $50.00 per drawing plan, or $300.00 maximum, whichever is less.

END OF SECTION
SECTION 26 05 19

POWER CONDUCTORS

PART 1 – GENERAL

1.1 Furnish and install wire and cable for branch circuits and feeders specified herein and as shown on the electrical drawings.

1.2 Submittals: Submit manufacturers’ data for the following items:
   1.2.1 All cables and terminations

1.3 Common submittal mistakes which will result in the submittals being rejected:
   1.3.1 Not including all items listed in the above itemized description.
   1.3.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining, or clouding the items to be reviewed, or crossing out the items which are not applicable.
   1.3.3 Not including actual manufacturer’s catalog information of proposed products.
   1.3.4 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed

PART 2 – PRODUCTS

2.1 Acceptable Wire Manufacturers: General Cable Technologies Corporation, Southwire Incorporated, Alpha Wire, Belden Inc., and Encore Wire Corporation.

2.2 Wire and cable Rated 120 volt to 600 volt.
   2.2.1 All wire and cable shall be new, 600 volt insulated copper, of types specified below for each application. All wire and cable shall bear the UL label and shall be brought to the job in unbroken packages. Wire insulation shall be the color as specified herein and shall be type THWN-2. Insulated conductors shall be installed in all exterior exposed raceways. Conductors for branch circuit lighting, receptacle, power and miscellaneous systems shall be a minimum of No. 12 AWG. Increase conductor size to No. 10 AWG for 120 volt circuits greater than 100 feet from the panel to the load and for 277 volt circuits greater than 200 feet from the panel to the load. Circuit home-runs indicated to be larger than No. 12 must be increased the entire length of the circuit, including equipment grounding conductor. Wire sizes No. 14 through No. 10 shall be solid. No. 8 and larger shall be stranded.

2.3 Wire and cable for systems below120 volts.
   2.3.1 All low voltage and communications systems cables routed underground shall be provided with a moisture resistant outer jacket, West Penn “Aquaseal” or equal, unless otherwise specified.
PART 3 - EXECUTION

3.1 Wire and cable shall be pulled into conduits without strain using powdered soapstone, mineralac, or other approved lubricant. In no case shall wire be repulled if same has been pulled out of a conduit run for any purpose. No conductor shall be pulled into conduit until conduit system is complete, including junction boxes, pull boxes, etc.

3.2 All connections of wires shall be made as noted below:

3.2.1 Connections to outlets and switches: Wire formed around binding post of screw.

3.2.2 No. 10 wire and smaller: Circuit wiring connections to lighting fixtures and other hard wired equipment shall be made with pressure type solderless connectors, Buchanan, Scotchlock, Wing Nut, or approved equal. Alternate "WAGO" #773 series or "IDEAL" #32, 33, 34 and 39 series push wire style connectors are also acceptable.

3.3 All wiring shall be continuous without splicing unless where specifically noted on the drawings or where permitted below.

3.3.1 No. 10 wire and smaller above grade: Quantities as needed, connection made with pressure type solderless connectors, Scotchlock or equal.

3.3.2 No. 10 wire and smaller below grade: Quantities as needed, connection made with 'Raychem' long barrel compression terminals with crimping tool and quantity of crimps as recommended by manufacturer, provide 'Raychem' WCSM-S series in-line heat shrink, sealant coated splice kit. Alternate products must be UL listed for direct burial/submersible and rated to (1000V).

3.3.3 No. 8 wire and larger above grade: Quantities only where indicated, 'Raychem' long barrel compression terminals with crimping tool and quantity of crimps as recommended by manufacturer, provide 'Raychem' WCSM-S series in-line heat shrink, sealant coated splice kit. Alternate products must be UL listed for direct burial/submersible and rated to (1000V).

3.3.4 No. 8 wire and larger below grade: Quantities only where indicated, 'Raychem' long barrel compression terminals with crimping tool and quantity of crimps as recommended by manufacturer, provide 'Raychem' WCSM-S series in-line heat shrink, sealant coated splice kit. Alternate products must be UL listed for direct burial/submersible and rated to (1000V).

3.4 All wiring throughout shall be color coded as follows:

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<thead>
<tr>
<th></th>
<th>480 volt system</th>
<th>208 or 240 volt system</th>
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<tbody>
<tr>
<td>A Phase</td>
<td>Brown</td>
<td>Black</td>
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<tr>
<td>B Phase</td>
<td>Orange</td>
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<tr>
<td>Neutral</td>
<td>Grey</td>
<td>White</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
<td>Green</td>
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3.5 Wiring must be color coded throughout its entire length, except feeders may have color coded plastic tape at both ends and any other accessible point.

3.6 All control wiring in a circuit shall be color coded, each phase leg having a separate color, and with all segments of the control circuit, whether in apparatus or conduit, utilizing the same color coding.
3.7 At all terminations of control wiring, the wiring shall have a numbered T&B or Brady plastic wire marker.

3.8 Cables when installed are to be properly trained in junction boxes, etc., and in such a manner as to prevent any forces on the cable which might damage the cable.

3.9 All conductors to be installed into a common raceway, shall be pulled into the raceway at the same time.

3.10 All conductors shall be installed in such a manner as to not exceed the manufacturers’ recommended pulling tension and bending radius. The equipment used for pulling must be specifically designed for the purpose. Motorized vehicles such as pickup trucks, are not acceptable.

END OF SECTION
SECTION 26 05 26

GROUNDING

PART 1 – GENERAL

1.1 Furnish and install grounding and grounding conductors and electrodes as specified herein and as shown on the drawings.

1.2 Submit catalog data for all components.

1.3 Common submittal mistakes which will result in the submittals being rejected:

1.3.1 Not including all items listed in the above itemized description.

1.3.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.3.3 Not including actual manufacturer’s catalog information of proposed products.

1.3.4 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – EXECUTION

2.1 Grounding

2.1.1 All panelboard cabinets, equipment, enclosures, and complete conduit system shall be grounded securely in accordance with pertinent sections of CEC Article 250. Conductors shall be copper. All electrically operated equipment shall be bonded to the grounded conduit system. All non-current carrying conductive surfaces that are likely to become energized and subject to personal contact shall be grounded by one or more of the methods detailed in CEC Article 250. All ground connections shall have clean contact surfaces. Install all grounding conductors in conduit and make connections readily accessible for inspection.

2.1.2 Provide an insulated equipment grounding conductor in all branch circuit and feeder raceway systems, sized in accordance with CEC 250-1122.

2.1.3 Provide an additional individual insulated grounding conductor for each circuit which contains an isolated ground receptacle or surge suppression receptacle.

2.1.4 Grounding of metal raceways shall be assured by means of provisions of grounding bushings on feeder conduit terminations at the panelboard, and by means of insulated continuous stranded copper grounding wire extended from the ground bus in the panelboard to the conduit grounding bushings.

2.1.5 Except for connections which access for periodic testing is required, make grounding connections which are buried or otherwise inaccessible by exothermite type process.

2.1.6 The following ohmic values shall be test certified for each item listed. A written report signed and witnessed by the project IOR shall be provided to the engineer. If the ohmic value listed cannot be obtained additional grounding shall be installed to reach the value listed.
2.1.6.1 Service .................. 10 ohms.

2.1.6.2 Step down transformers and non-current carrying metal parts
......................... 25 ohms.

2.1.6.3 Manholes, handholes, etc.
......................... 10 ohms.

END OF SECTION
PART 1 – GENERAL

1.1 Furnish and install conduit and fittings as shown on the drawings and as specified herein.

1.2 Submit Manufacturer’s data on the following:
   1.2.1 Conduit.
   1.2.2 Fittings
   1.2.3 Fire stopping Material.
   1.2.4 Surface Raceways.

1.3 *Common submittal mistakes which will result in the submittals being rejected:*
   1.3.1 Not including all items listed in the above itemized description.
   1.3.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.
   1.3.3 Not including actual manufacturer’s catalog information of proposed products.
   1.3.4 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 Rigid steel conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT) and flexible metallic conduit shall be steel, hot dipped galvanized after fabrication.

2.2 Metal conduit shall be manufactured by Allied Tube and Conduit, Electriflex Company, O-Z/Gedney, Republic Conduit, Robroy Industries, Thomas & Betts Corp., Western Tube and Conduit Corp., or Wheatland Tube Company.

2.3 PVC and other non-metallic conduit shall be manufactured by Cantex, Condux Inc., Electri-Flex Company, Lamson & Sessions(Carlon), RACO, or Thomas & Betts.

2.4 Liquid tight flexible metal conduit shall be Anacoda Sealtite type UA or approved equal. Fittings shall be Appleton, Crouse-Hinds, Steel City, T&B, or equivalent.

2.5 MC and MC-PCS type armored cable shall not be used.

2.6 Fire stopping material shall provide an effective seal against fire, heat, smoke and fire gases. Fire stopping material shall be tested to comply with ASTME 814 and UL 1479. The submittal for this product shall include the UL listed system number and installation requirements for each type of penetration seal required for this project.

2.7 Each length of conduit shall be stamped with the name or trademark of the manufacturer and shall bear the UL label.
2.8 All plastic conduit shall be rigid, schedule 40, heavy wall PVC. All PVC conduit shall be UL listed. Underground utility company conduits shall comply with local utility co. requirements.

2.9 Plastic conduit shall be stored on a flat surface, and protected from the direct rays of the sun.

2.10 Where branch circuit or communication raceways cannot be concealed in ceilings or walls and are required to be exposed in interior spaces, provide nonmetallic surface raceway system sized per the manufacturer capacity requirements. A full complement of nonmetallic fittings must be available and matching device boxes and cover plates must be provided. The color of the raceway system, components and boxes shall be (white). Where data networking cabling is to be installed, all raceway fittings shall meet Category 5 radius requirements. Where specific raceway types have been noted on the drawings they shall be as follows:

2.10.1 System 'SR'  
Hubbell  WALLTRAK 1 series  
Wiremold  ECLIPSE PN05 series  
Panduit  LD5 series  
Hellerman-Tyton  TSR2 series

2.10.2 System 'SR2'  
Hubbell  WALTRAK 22  
Wiremold  2300D Series  
Panduit  D2P10  
Hellerman-Tyton  TSR3 series

2.10.3 System 'SR3'  
Hubbell  BASETRAK series  
Wiremold  5400 - series  
Panduit  70 series  
Hellerman-Tyton  MCR Infostream" series

Provide with offset boxes, inline boxes may only be used where specifically shown on the drawings.

PART 3 – FITTINGS

3.1 All metallic fittings, including those for EMT, flexible conduit, or malleable iron. Die cast fittings of any other material are not permitted.

3.2 Locknuts shall be steel or malleable iron with sharp clean cut threads.

3.3 Entrance seals shall be O.Z. type FSK or equivalent.

3.4 Bushings and locknuts: Where conduits enter boxes, panels, cabinets, etc., they shall be rigidly clamped to the box by locknuts on the outside, and a lock nut and plastic bushing on the inside of the box. All conduits shall enter the box squarely.

3.5 Furnish and install insulated bushings as per CEC article No. 300 - 4 (F) on all conduits. The use of insulated bushings does not exclude the use of double locknuts to fasten conduit to the box.

3.6 Transition from plastic to steel conduits shall be with PVC female threaded adaptors.

3.7 Couplings and connectors for rigid steel or IMC conduit must be threaded, or compression type (set screw fittings are not permitted).
3.8 Couplings and connectors for EMT shall be compression, watertight. Set screw connectors are not acceptable, except for systems below 120 volts.

3.9 Connectors for flexible metal conduit shall be steel or malleable iron with screw provided to clinch the conduit into the adapter body. For sizes up to ¾” a screw-in, “Jake type,” fitting may be used.

3.10 Install approved expansion fittings, or liquid tight flex conduit with a minimum 6” slack for conduits passing through all expansion and seismic joints.

PART 4 - EXECUTION

4.1 All branch circuits shall be installed concealed in walls or above ceilings or in concrete floor slabs. PVC conduits installed in concrete floor slabs shall transition to PVC coated rigid steel where conduits penetrate above finished grade or finished floor.

4.2 Conduit sizes for various numbers and sizes of wire shall be as required by the CEC, but not smaller than 3/4” for power wiring and ¾” for communications and fire alarm systems unless otherwise noted. Conduit in slab or below grade shall be ¾” minimum trade size, unless otherwise identified.

4.3 Conduit size shall be such that the required number and sizes of wires can be easily pulled in and the Contractor shall be responsible for the selection of the conduit sizes to facilitate the ease of pulling. Conduit sizes shown on the drawings are minimum sizes in accordance with appropriate tables in the CEC. If because of bends or elbows a larger conduit size is required, the Contractor shall so furnish without further cost to the Owner.

4.4 The Contractor shall be entirely responsible for the proper protection of this work from the other trades on the job. When conduit becomes bent or holes are punched through same, or outlets moved after being roughed-in, the Contractor shall replace same, without additional cost to the Owner.

4.5 Rigid steel conduit or IMC shall be used as follows:

4.5.1 Exposed exterior locations.

4.5.2 Exposed interior locations below eight feet above floor, except in electrical rooms and closets.

4.5.3 In hazardous or classified areas as required by CEC.

4.6 EMT conduit shall be used for areas as follows:

4.6.1 All interior communications, signal, and data networking systems.

4.6.2 All interior power wiring systems where not required to be in rigid steel, IMC or flexible conduit.

4.7 Flexible conduit shall be used for areas as follows:

4.7.1 To connect motors, transformers, and other equipment subjected to vibration or where specifically detailed on the drawings.

4.7.2 Flexible conduit shall not be used to replace EMT in other locations where the conduit will be exposed.
4.7.3 Flexible metal conduit shall be ferrous. Installation shall be such that considerable slack is realized. The conduit shall contain separate code sized grounding conductor.

4.7.4 Liquid tight flexible conduit shall be used in conformance with CEC in lengths not to exceed 4’. For equipment connections, route the conduit at 90 degrees to the adjacent path for point of connection. The conduit shall contain separate code sized grounding conductor. Use liquid tight flexible conduit for all equipment connections exposed in possible wet, corrosive or oil contaminated areas, e.g., shops and outside areas.

4.8 MC and MC-PCS armored cable shall not be used.

4.9 Plastic conduit shall be used for all exterior underground, in slab, and below slab on grade conduit installations. Install bell ends at all conduit terminations in manholes and pull boxes. Where plastic conduit transitions from below grade to above grade, no plastic conduit shall extend above finished exterior grade, or above interior finished floor level.

4.10 Plastic conduit joints shall be made up in accordance with the manufacturer’s recommendations for the particular conduit and coupling selected. Conduit joint couplings shall be made watertight. Plastic conduit joints shall be made up by brushing a plastic solvent cement on the inside of a plastic fitting and on the outside of the conduit ends. The conduit and fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly.

4.11 All underground conduit depths shall be as detailed on the drawings or a minimum of 30" below finished grade (when not specifically detailed otherwise), for all exterior underground conduits. Where concrete slurry or concrete encasement is provided, include “Red” color dye in mixture.

4.12 All underground conduits for power systems (600v and higher), shall be concrete encased and a minimum of 48” below grade or as detailed on the drawings. Where concrete slurry or concrete encasement is provided, include “Red” color dye in mixture.

4.13 Conduit shall be continuous from outlet to outlet, cabinet or junction box, and shall be so arranged that wire may be pulled in with the minimum practical number of junction boxes.

4.14 All conduits shall be concealed wherever possible. All conduit runs may be exposed in mechanical equipment rooms, electrical equipment rooms, electrical closets, and in existing or unfinished spaces. No conduit shall be run exposed in finished areas without the specific approval of the Architect.

4.15 All raceways which are not buried or embedded in concrete shall be supported by straps, clamps, or hangers to provide a rigid installation. Exposed conduit shall be run in straight lines at right angles to or parallel with walls, beams, or columns. In no case shall conduit be supported or fastened to other pipes or installed to prevent the ready removal of other trades piping. Wire shall not be used to support conduit.

4.16 It shall be the responsibility of the Contractor to consult the other trades before installing conduit and boxes. Any conflict between the location of conduit and boxes, piping, duct work, or structural steel supports, shall be adjusted before installation. In general, large pipe mains, waste, drain, and steam lines shall be given priority.

4.17 Conduits above lay-in grid type ceilings shall be installed in such a manner that they do not interfere with the “lift-out” feature of the ceiling system. Conduit runs shall be installed to maintain the following minimum spacing wherever practical.

4.17.1 Water and waste piping not less than 3".
4.17.2 Steam and steam condensate lines not less than 12”.

4.17.3 Radiation and reheat lines not less than 6”.

4.18 Provide all necessary sleeves and chases required where conduits pass through floors or walls as part of the work of this section. Core drilling will only be permitted where approved by the Architect.

4.19 All empty conduits and surface mounted raceways shall be provided with a ¼" polypropylene plastic pull cord and threaded plastic or metal plugs over the ends. Fasten plastic "Dymo" tape label to exposed spare conduit to identify "power" or "communication" system, and to where it goes.

4.20 The ends of all conduits shall be securely plugged, and all boxes temporarily covered to prevent foreign material from entering the conduits during construction. All conduit shall be thoroughly swabbed out with a dry swab to remove moisture and debris before conductors are drawn into place.

4.21 Bending: Changes in direction shall be made by bends in the conduit. These shall be made smooth and even without flattening the pipe or flaking the finish. Bends shall be of as long a radius as possible, and in no case smaller than CEC requirements.

4.21.1 For power conduits for conductors (600v and below), provide minimum 36” radius (vertical) and 72” radius (horizontal) bends.

4.21.2 For power conduits for conductors (greater than 600v), provide minimum 72” radius (vertical) and 72” radius (horizontal) bends.

4.22 Supports: Conduit shall be supported at intervals as required by the California Electrical Code. Where conduits are run individually, they shall be supported by approved conduit straps or beam clamps. Straps shall be secured by means of toggle bolts on hollow masonry, machine screws or bolts on metal surfaces, and wood screws on wood construction. Conduits installed exposed in damp locations shall be provided with clamp backs under each conduit clamp, to prevent accumulation of moisture around the conduits.

4.23 Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers. Hanger rods shall be fastened to structural steel members with suitable beam clamps or to concrete inserts set flush with surface. A reinforced rod shall be installed through the opening provided in the concrete inserts. Beam clamps shall be suitable for structural members and conditions. Rods shall be galvanized steel 3/8" diameter minimum. Each conduit shall be clamped to the trapeze hanger with conduit clamps.

4.24 All concrete inserts and pipe clamps shall be galvanized. All steel bolts, nuts, washers, and screws shall be galvanized or cadmium plated. Individual hangers, trapeze hangers and rods shall be prime-coated.

4.25 Openings through fire rated floors/walls and/or smoke walls through which conduits pass shall be sealed by Fire stopping material to comply with Division 1 to seal off flame, heat, smoke and fire gases. Sleeves shall be provided for power or communication system cables which are not installed in conduits, and shall be sealed inside and out to comply with manufacturers UL system design details. Where multiple conduits and/or cable tray systems pass thru fire-rated walls at one location, the Contractor shall submit copies of the manufacturers UL system design details proposed for use on this project. All Fire stopping material shall have an hourly fire-rating equal to or higher than the fire rating of the floor or wall through which the conduit, cables, or cable trays pass.
4.26 Provide cap or other sealing type fitting on all spare conduits. Conduits stubbed into buildings from underground where cable only extends to equipment, the conduit/cable end shall be sealed to prevent moisture from entering the room or space.

4.27 All conduits which are part of a paralleled feeder or branch circuit shall be installed underground.

4.28 All conduits which are required as a part of systems specified in Divisions 27 or 28, or any other low voltage communication systems, shall be furnished and installed by the Division 26 Contractor.

4.28.1 The Contractor shall coordinate all conduit requirements with each system supplier prior to bid to determine special conduit system requirements.

4.28.2 The Contractor shall provide a pull rope in all conduits for these systems.

4.28.3 The Contractor shall provide conduit sleeves for all open cable installations thru rated walls or block walls. Provide conduit from each building main termination cabinet or backboard to the nearest accessible ceiling for access into all electrical or communications rooms.

4.29 In addition to the above requirements, the following requirements shall apply to all data networking conduits:

4.29.1 Flexible metal conduit may only be used where required at building seismic and/or expansion joints.

4.29.2 All underground conduits shall be provided with minimum 24” radius elbows (vertical) and 60” (horizontal).

4.29.3 No length of conduit above grade shall be installed to exceed 150 feet between pull boxes, or points of connection, unless where specifically detailed on the drawings.

4.29.4 No length of conduit shall be installed to exceed two 90 degree bends between pull boxes, or points of connection, unless where specifically detailed on the drawings.

4.30 Where surface raceways are installed in interior spaces, the Contractor shall take care to route in straight lines at right angles to or parallel with walls, beams, or columns. All raceways and device boxes shall be securely screwed to the finish surface with zinc screw “Auger” anchors Stk #ZSA1K by Gray Bar Electric or equal. Tape adhesive application will not be permitted.

4.31 The Contractor who installs surface raceway systems shall provide and install complete with wire retention clips, one for every (8) vertical feet or (5) horizontal feet or portion thereof. This Contractor shall also provide each raceway channel with pull strings.

4.32 It shall be the responsibility of the Contractor installing the raceway to coordinate the installation of raceway device plates and inserts with the communications or data contractors.

END OF SECTION
SECTION 26 05 34
OUTLET AND JUNCTION BOXES

PART 1 – GENERAL

1.1 Furnish and install electrical wiring boxes as specified and as shown on the electrical drawings.

1.2 Submit manufacturer's data for all items.

1.3 Common submittal mistakes which will result in the submittals being rejected:

1.3.1 Not including all items listed in the above itemized description.

1.3.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.3.3 Not including actual manufacturer’s catalog information of proposed products.

1.3.4 Do not include multiple manufacturers for similar products and do not indicate "or approved equal" statements, or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 Boxes shall be as manufactured by Steel City, Appleton, Raco, or approved equal.

2.2 All boxes must conform to the provisions of Article 370 of the CEC. All boxes shall be of the proper size to accommodate the quantity of conductors enclosed in the box. Minimum box size shall be 4” square x 1-½” deep.

2.3 Boxes generally shall be hot dipped galvanized steel with knockouts. Boxes on exterior surfaces or in damp locations shall be corrosion resistant, cast feraloy and shall have threaded hubs for rigid conduit and neoprene gaskets for their covers. Boxes shall be Appleton Type FS, Crouse-Hinds, or the approved equal. Conduit bodies shall be corrosion resistant, cast malleable iron. Conduit bodies shall have threaded hubs for rigid conduit and neoprene gaskets for their covers. Conduit bodies shall be Appleton Unilets, Crouse-Hinds, or the approved equal. Where recessed, boxes shall have square cut corners.

2.4 Deep boxes shall be used in wall covered by wainscot or paneling and in walls or glazed tile, brick, or other masonry which will not be covered with plaster. Through the wall type boxes shall not be used unless specifically called for. All boxes shall be nongangable. Boxes in concrete shall be of a type to allow the placing of conduit without displacing the reinforcing bars. All lighting fixture outlet boxes shall be equipped with the proper fittings to support and attach a light fixture.

2.5 All light, switch, receptacle, fire alarm devices and similar outlets shall be provided with approved boxes, suitable for their function. Back boxes shall be furnished and installed as required for the equipment and/or systems under this contract.

2.6 Pull and junction boxes shall be code gauge boxes with screw covers. Boxes shall be rigid under torsional and deflecting forces and shall be provided with angle from framing where required. Boxes shall be 4” square with a blank cover in unfinished areas and with
a plaster ring and blank cover in finished areas. Covers for flush mounted oversize boxes shall extend ¾" past boxes all around. Covers for 4" square boxes shall extend ¼" past box all around.

2.7 All terminal cabinets and junction boxes or equipment back boxes which are required as a part of systems specified in Divisions 27 or 28, or any other low voltage communication systems, shall be furnished and installed by the Division 26 Contractor.

2.7.1 The Division 26 Contractor shall coordinate all box requirements with each system supplier prior to bid to determine special cabinet or back box requirements. The Contractor shall also provide stainless steel blank cover plates for all low voltage systems installed for future equipment.

2.7.2 The Contractor shall provide all plywood backboards indicated on walls or inside equipment enclosures. All backboards shall be a minimum of ¼" thick fire rated type plywood.

2.7.3 The Contractor shall coordinate exact rough in locations and requirements with each system supplier.

2.8 In addition to the above requirements, boxes for data networking wiring and equipment shall comply with the following:

2.8.1 All boxes shall be a minimum of 4-11/16" square x 2-1/8" deep.

2.8.2 Where pull boxes are required on individual conduits 1-¼" or smaller, provide 4-11/16" square x 2-1/8" deep boxes. Where pull boxes are required on conduits larger than 1-¼" for straight pull through, provide eight times the conduit trade size for box length. Where pull boxes are required on conduits larger than 1-¼" for an angle or a U-pull through installation, provide a minimum distance of six times the conduit trade size between the entering and exiting conduit run for each cable.

2.9 Recessed boxes installed in fire rated floors/walls and/or smoke walls shall be sealed by Fire stopping material to comply with Division 1 to seal off flame, heat, smoke and fire gases. The Contractor shall submit copies of the manufacturers UL system design details proposed for use on this project. All Fire stopping material shall have an hourly fire-rating equal to or higher than the fire rating of the floor or wall through which the conduit, cables, or cable trays pass.

PART 3 – EXECUTION

3.1 Boxes shall be installed where required to pull cable or wire, but in finished areas only by approval of the Architect. Boxes shall be rigidly attached to the structure, independent of any conduit support. Boxes shall have their covers accessible. Covers shall be fastened to boxes with machine screws to ensure continuous contact all around. Covers for surface mounted boxes shall line up evenly with the edges of the boxes.

3.2 Outlets are only approximately located on the plans and great care must be used in the actual location of the outlets by consulting the various detailed drawings and specifications. Outlets shall be flush with finished wall or ceiling, boxes installed symmetrically on such trim or fixture. Refer to drawings for location and orientation of all outlet boxes.

3.3 Furnish and install all plaster rings as may be required. Plaster rings shall be installed on all boxes where the boxes are recessed. Plaster rings shall be of a depth to reach the finished surface. Where required, extension rings shall be installed so that the plaster ring is flush with the finished surface.
3.4 All cabinets and boxes shall be secured by means of toggle bolts on hollow masonry; expansion shields and machine screws or standard precast inserts on concrete or solid masonry; machine screws or bolts on metal surfaces and wood screws on wood construction. All wall and ceiling mounted outlet boxes shall be supported by bar supports extending from the studs or channels on either side of the box. Boxes mounted on drywall or plaster shall be secured to wall studs or adequate internal structure.

3.5 Boxes with unused punched-out openings shall have the openings filled with factory-made knockout seals.

3.6 Where standby power and normal power are to be located in the same outlet box or 480V in a switch box, install partition barriers to separate the various systems.

3.7 All device boxes and junction boxes for fire alarm system shall be painted red and shall be 4-11/16” square by 2-1/8” deep. No exceptions.

END OF SECTION
SECTION 26 05 43

UNDERGROUND PULL BOXES AND MANHOLES

PART 1 – GENERAL

1.1 Furnish and install electrical underground pullboxes and manholes as specified and as shown on the electrical drawings.

1.2 Submit manufacturer's data for all items.

1.3 **Common submittal mistakes which will result in the submittals being rejected:**

   1.3.1 Not including all items listed in the above itemized description.

   1.3.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

   1.3.3 Not including actual manufacturer’s catalog information of proposed products.

   1.3.4 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 Acceptable manufacturers for underground pull boxes are Jensen Precast Inc., CDR Systems Corp., Old Castle Precast Inc., or Synertech Moulded Products.

2.2 The concrete for pull boxes and manholes shall be class 5500 psi or as noted on the drawings. All pullboxes and manholes and covers located in parking lots, driveways, roads, or any other driveable areas shall be traffic rated.

2.3 Each manhole shall be provided with a fiberglass ladder and ground rod. Ground rods shall be copper or a copper-clad steel 3/4" diameter by 10-feet long. All non-current carrying metallic components shall be grounded to the ground rods with minimum #6 copper wire.

2.4 All underground pullboxes shall be provided with steel bolt down type covers. Bolts shall be bronze or brass. All communication or signal system pullboxes shall be sized to comply with CEC Article 370 unless where other sizes are specifically noted on the drawings.

2.5 All underground pullbox and manhole covers shall be provided with either "electrical" or "telephone" or "fire alarm" markings. The telephone marking shall be used to identify telephone, T.V., clock or any other types of communication systems.

2.6 All power and communication systems shall be provided with separate pullboxes or manholes. Fire alarm circuits shall also be provided with separate pullboxes from any other type of communication systems.

PART 3 – INSTALLATION

3.1 Shoring of the excavation shall be in accordance with all federal, state and local regulations.

3.2 Provide sealing material for the joints between sections per manufacturer’s instructions.
3.3 The contractor shall make the top and access assembly or lid flush with surrounding areas where installed in driveable or normal walking areas.
SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

RELATED DOCUMENTS

1.1 For commissioning requirements of all electrical systems, see specification section 01 91 13 – General Commissioning requirements.

PART 2 – PRODUCTS

2.1 Not applicable

PART 3 - EXECUTION

3.1 Not applicable

END OF SECTION
PART 1 – GENERAL

1.1 Furnish and install automatic lighting controls as shown on the drawings and as specified herein. Submit manufacturers’ data on all items.

1.2 Equipment shall be UL listed, comply with those portions of CEC as applicable to electrical wiring work and comply with those portions of NEMA or UL pertaining to types of electrical equipment and enclosures. The equipment shall also be certified by the California Energy Commission.

1.3 The manufacturer of the lighting control equipment shall have been actively engaged in the manufacture of the types and capacities required for the application for at least three years. It is the sole responsibility of the Division 26 contractor to ensure that submittals of material meet the performance specifications contained herein.

1.4 All components and assemblies shall be factory pre-tested and burned-in as a system for 48 hours prior to shipping.

1.5 Control Intent – Control Intent includes, but is not limited to:

1.5.1 Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.

1.5.2 Initial sensor and switching zones

1.5.3 Initial time switch settings

1.5.4 Task lighting and receptacle controls

1.5.5 Emergency Lighting control (if applicable)

1.5.6 Manufacturer shall submit a point-to-point line diagram of the system configuration including all devices and accessories required to complete the system.

1.5.7 Manufacturer shall submit data sheets on the components and system submitted, with descriptions of hardware and software components.

SYSTEM DESCRIPTION & OPERATION

1.6 The Lighting Control and Automation system as defined under this section covers the following equipment:

1.6.1 Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications

1.6.2 Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications

1.6.3 Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications.
Remote may be configured in the field to control selected loads or scenes without special tools

1.6.4 Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting

1.6.5 Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities

1.6.6 Digital Plug-Load Controllers – Self-configuring, digitally addressable, single relay, plenum-rated application-specific controllers. Selected models include integral current monitoring capabilities

1.6.7 Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings

1.6.8 Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices

1.6.9 Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded,) to connect multiple DLM local networks for centralized control

1.6.10 Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.

1.6.11 Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting

1.6.12 Programming and Configuration software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication

1.6.13 LMCP Digital Lighting Management Relay Panel – provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS)

1.6.14 Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building
LIGHTING CONTROL APPLICATIONS

1.7 Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:

1.7.1 Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.

1.7.2 Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used

1.7.3 Task Lighting / Plug Loads – Provide automatic shut off of non-essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide Automatic-ON of plug loads whenever spaces are occupied. For spaces with multiple occupants a single shut off consistent with the overhead lighting may be used for the area

1.7.4 Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:

1.7.4.1 All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones

1.7.4.2 Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes

1.7.4.3 Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings

1.7.4.4 Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

1.7.5 Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.8 Submit shop drawings and manufacturers’ data for all components including:

1.8.1 Manufacturer shall submit in bill-of-material form an itemized list of all materials supplied to meet the specification.

1.8.2 Manufacturer shall submit dimensional drawings of lighting control panel(s).
1.8.3 Manufacturer shall submit a point-to-point line diagram of the system configuration including all devices and accessories required to complete the system.

1.8.4 Manufacturer shall submit data sheets on the components and system submitted, with descriptions of hardware and software components.

1.8.5 Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.

1.8.6 Show exact location of all digital devices, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans)

1.8.7 Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

1.8.8 Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

QUALITY ASSURANCE

1.9 Manufacturer: Minimum 10 years' experience in manufacture of lighting controls.

PROJECT CONDITIONS

1.10 Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1.10.1 Ambient temperature: 0° to 40° C (32° to 104° F)

1.10.2 Relative humidity: Maximum 90 percent, non-condensing.

WARRANTY

1.11 Provide a five year limited manufacturer’s warranty on all room control devices and panels.

MAINTENANCE

1.12 Spare Parts:

1.12.1 Provide 5% spares of each product to be used for this project. All unused items shall be boxed and delivered to the owner at the completion of the project.

PART 2 – PRODUCTS

Acceptable Manufacturers: Nlight Network Control System by Lithonia

2.1 No substitutions will be accepted.

DIGITAL LIGHTING CONTROLS

SYSTEM REQUIREMENTS
2.2 System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.

2.3 Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

2.4 System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section).

2.5 Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and posses RJ-45 style connectors.

2.6 Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

2.7 Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.

2.8 Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

2.9 Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

2.10 Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.

2.11 All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

2.12 System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

2.13 System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.

2.14 System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.

2.15 WiFi enabled devices shall be able to detect when WiFi network is down and revert to a user directed default state.

2.16 WiFi-enabled devices shall be capable of current monitoring

2.17 WiFi-enabled devices shall utilize WPA2 AES encryption.
2.18 WiFi-enabled devices shall be able to connect to 802.11b/g/n WiFi networks

2.19 WiFi-enabled devices shall have at least one local RJ-45 port for communicating with nonWiFi-enabled system devices

2.20 System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.

2.21 Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

2.22 Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.

2.23 System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.

2.23.1 Auto-On / Auto-Off (via occupancy sensors)

2.23.1.1 Zones with occupancy sensors automatically turn lights on when occupant is detected

2.23.1.2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected

2.23.1.3 Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality

2.23.2 Manual-On / Auto-Off (also called Semi-Automatic)

2.23.2.1 Pushing a switch will turn lights on.

2.23.2.2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected

2.23.3 Manual-On to Auto-On/Auto-Off

2.23.3.1 Pushing a switch will turn lights on.

2.23.3.2 After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.

2.23.3.3 Sequence can be reset via scheduled (ex. daily each morning) events

2.23.4 Auto-to-Override On

2.23.4.1 Zones with occupancy sensors automatically turn lights on when occupant is detected.

2.23.4.2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
2.23.4.3 Sequence can be reset via scheduled (ex. daily each morning) events

2.23.5 Manual-to-Override On

2.23.5.1 Pushing a switch will turn lights on.

2.23.5.2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.

2.23.5.3 Sequence can be reset via scheduled (ex. daily each morning) events

2.23.6 Auto On / Predictive Off

2.23.6.1 Zones with occupancy sensors automatically turn lights on when occupant is detected

2.23.6.2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

2.23.6.3 If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

2.23.7 Multi-Level Operation (multiple lighting levels per manual button press)

2.23.7.1 Operating mode designed specifically for bi-level applications

2.23.7.2 Enables the user to cycle through the up to four potential on/off lighting states using only a single button.

2.23.7.3 Eliminates user confusion as to which of two buttons controls which load

2.23.7.4 Three different transition sequences are available in order to comply with energy codes or user preference

2.23.7.5 Mode available as a setting on all nLight devices that have single manual on/off switch (ex. nWSX, nPODM, nPODM-DX).

2.23.7.6 Depending on the sequence selected, every button push steps through relays states according to below table

2.23.7.7 In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present

<table>
<thead>
<tr>
<th>Sequence State #</th>
<th>Alternating Sequence</th>
<th>Full On Sequence</th>
<th>3 Step On Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay 1 Relay 2</td>
<td>On Off</td>
<td>On Off</td>
<td>On Off</td>
</tr>
<tr>
<td>Relay 1 Relay 2</td>
<td>On Off</td>
<td>On Off</td>
<td>On Off</td>
</tr>
<tr>
<td>Relay 1 Relay 2</td>
<td>On Off</td>
<td>On Off</td>
<td>On Off</td>
</tr>
<tr>
<td>Relay 1 Relay 2</td>
<td>On Off</td>
<td>On Off</td>
<td>On Off</td>
</tr>
</tbody>
</table>
2.24 A taskbar style desktop application shall be available for personal lighting control.

2.25 An application that runs on “smart” handheld devices (such as an Apple® iPhone®) shall be available for personal lighting control.

2.26 Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.

2.27 Control software shall enable integration with a BMS via BACnet IP.

2.28 System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.29 Each addressable point on the system shall be labeled within the program: by Campus, building number, room number and device type (ex. CLC 301 Power pack)

INDIVIDUAL DEVICE SPECIFICATIONS

2.30 Control Module (Gateway)

2.30.1 Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.

2.30.2 Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.

2.30.3 Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.

2.30.4 Device shall automatically detect all devices downstream of it.

2.30.5 Device shall have a standard and astronomical internal time clock.

2.30.6 Device shall have one RJ-45 10/100 BaseT Ethernet connection.

2.30.7 Device shall have a USB port

2.30.8 Each control gateway device shall be capable of linking 1500 devices to the management software.

2.30.9 Device shall be capable of using a dedicated or DHCP assigned IP address.

2.30.10 Network Control Gateway device shall be the following Sensor Switch model Series:

Ngwy2

2.31 Networked System Occupancy Sensors
2.31.1 Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

2.31.2 All sensors shall be dual technology sensors.

2.31.3 Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.

2.31.4 All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

2.31.5 Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.

2.31.6 Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.

2.31.7 Sensors shall be available in multiple lens options which are customized for specific applications.

2.31.8 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

2.31.9 All sensors shall have two RJ-45 ports or capable of utilizing a splitter.

2.31.10 All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue

2.31.11 Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.

2.31.12 Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.

2.31.13 Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.

2.31.14 Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening

2.31.15 Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
2.31.16 Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.

2.31.17 Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)

2.31.18 Wall switch sensors shall be available with optional raise/lower dimming adjustment controls

2.31.19 Wall switch sensors shall be the following Sensor Switch model numbers, with device color and optional features as specified:

- nWSD PDT or nWSX PDT (Dual Tech, 1 Relay)
- nWSD PDT NL (Dual Tech w/ Night Light, 1 Relay)
- nWSD PDT NL LV (Dual Tech w/ Night Light, No Relay)
- nWSD PDT LV or nWSX PDT LV (Dual Tech w/ Night Light, No Relay, Raise/Lower Dim Ctrl)

2.31.20 Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.

2.31.21 Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection

2.31.22 Embedded sensors shall have an optional photocell

2.31.23 Embedded sensors shall be the following Sensor Switch model number

- nES PDT 7 (Dual Technology, No Relay)
- nES PDT 7 ADCX (Dual Technology w/ Photocell, No Relay)

2.31.24 Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.

2.31.25 Fixture mount sensors shall be capable of powering themselves via a line power feed.

2.31.26 Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.

2.31.27 Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

2.31.28 Sensors shall be the following Sensor Switch model numbers, with device option as specified:
Recessed mount versions of the above ceiling (fixture) mount versions also shall be available (e.g. nCMR(B) 9 => nRMR 9)

2.31.29 System shall have WiFi enabled fixture mountable sensors available.

2.31.30 Embedded sensors shall have an optional photocell and 0-10 VDC dimming output

2.31.31 WiFi enable sensors shall be one of the Sensor Switch model numbers

<table>
<thead>
<tr>
<th>Model # Series</th>
<th>Occupancy Poles</th>
<th># of Relays</th>
<th>Lens Type</th>
<th>Detection Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>nCM(B) PDT 9</td>
<td>1</td>
<td>-</td>
<td>Standard</td>
<td>Dual</td>
</tr>
<tr>
<td>nCM(B) PDT 9 2P</td>
<td>2</td>
<td>-</td>
<td>Standard</td>
<td>Dual</td>
</tr>
<tr>
<td>nCMR(B) PDT 9</td>
<td>1</td>
<td>1</td>
<td>Standard</td>
<td>Dual</td>
</tr>
<tr>
<td>nCMR(B) PDT 9 2P</td>
<td>2</td>
<td>2</td>
<td>Standard</td>
<td>Dual</td>
</tr>
<tr>
<td>nCM(B) PDT 10</td>
<td>1</td>
<td>-</td>
<td>Extended</td>
<td>Dual</td>
</tr>
<tr>
<td>nCM(B) PDT 10 2P</td>
<td>2</td>
<td>-</td>
<td>Extended</td>
<td>Dual</td>
</tr>
<tr>
<td>nCMR(B) PDT 10</td>
<td>1</td>
<td>1</td>
<td>Extended</td>
<td>Dual</td>
</tr>
<tr>
<td>nCMR(B) PDT 10 2P</td>
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<td>2</td>
<td>Extended</td>
<td>Dual</td>
</tr>
<tr>
<td>nWV PDT 16</td>
<td>1</td>
<td>-</td>
<td>Wide View</td>
<td>Dual</td>
</tr>
</tbody>
</table>

2.32 Networked System Daylight (Photocell and or Dimming) Sensors

2.32.1 Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

2.32.2 Photocell and dimming sensor’s set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an “Automatic Set-point Programming” procedure. Min and max dim settings as well as set-point may be manually entered.

2.32.3 Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

2.32.4 Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).

2.32.5 Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the “auto set-point” setting.)

2.32.6 Combination units that have all features of on/off photocell and dimming sensors shall also be available.

2.32.7 A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an “offset” from the primary zone.
2.32.8 Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.

2.32.9 Sensor shall be the following Sensor Switch model numbers, with device options as specified:

- nCM(B) PC (on/off))
- nCM(B) ADC (dimming)
- nCM(B) PC ADC (on/off, 0-10 VDC dimming)
- nCMR(B) PC (on/off, single relay)
- nCMR(B) PC ADC (on/off, 0-10 VDC dimming, single relay)

Note: Recessed mount versions of the above ceiling(fixture) mount versions also shall be available (e.g. nCMR(B) PC => nRMR PC)

2.32.10 Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.

2.32.11 Embedded sensors shall be the following Sensor Switch model number:

- nES ADCX (Dimming Photocell)

2.33 Networked System Power (Relay) Packs

2.33.1 Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.

2.33.2 Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.

2.33.3 All devices shall have two RJ-45 ports.

2.33.4 Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.

2.33.5 Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

2.33.6 When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

2.33.7 Power Packs and Power Supplies shall be available that are WiFi enabled.
2.33.8 Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.

2.33.9 Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.

2.33.10 Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.

2.33.11 Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).

2.33.12 Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC magnetic low voltage transformers.

2.33.13 Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.

2.33.14 Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.

2.33.15 Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.

2.33.16 Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.

2.33.17 Specific Secondary Packs shall be available that control louver/damper motors for skylights.

2.33.18 Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

2.33.19 Power (Relay) Packs and Supplies shall be the following Sensor Switch model Series

- nPP16 (Power Pack w/ 16A relay)
- nPP16 WIFI (Power Pack w/ 16A relay, WIFI enabled)
- nEPP5 D (Power Pack w/ 5A relay and 0-10VDC dimming output)
- nSP16 (Secondary Pack w/ 16A relay)
- nSP5 2P (Secondary Pack w/ two 5A relays)
- nSP5 D (Secondary Pack w/ 5A relay and 0-10VDC dimming output)
- nPP16 ER (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits)
- nSP5 D ER (UL924 Listed Secondary Pack w/ 5A relay and 0-10VDC dimming output for switching emergency power circuits)
- nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)
- nSP5 PCD 3W (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output)
nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)

nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output)

nSP5 480 (Secondary Pack w/ 5A relay for switching 208/240/480 VAC loads)

nSP5 2P LVR (Louver/Damper Control Pack)

nSHADE (Pulse On/Off Control Pack)

nPS 80 (Auxiliary Bus Power Supply)

nPS 80 WIFI (Auxiliary Bus Power Supply, WiFi enabled)

nAR 40 (Low voltage auxiliary relay pack)

2.34 Networked System Relay & Dimming Panels

2.34.1 Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.

2.34.2 Relays shall be rated to switch up to a 30A ballast load at 277 VAC.

2.34.3 Panel shall provide one 0-10VDC dimming output paired with each relay.

2.34.4 Panel shall power itself from an integrated 120/277 VAC supply.

2.34.5 Panel shall be capable of operating as either two networked devices or as one.

2.34.6 Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.

2.34.7 Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.

2.34.8 Power (Relay) Packs and Supplies shall be the following Sensor Switch model numbers:

nPANEL 4 (Panel w/ four 120/277 VAC relays and four 0-10 VDC dimming outputs)

nPANEL 2 480 (Panel w/ two dual phase relays (208/240/480 VAC) and two 0-10 VDC dimming outputs)

2.35 Networked Auxiliary Input / Output (I/O) Devices

2.35.1 Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.

2.35.2 Devices shall have two RJ-45 ports

2.35.3 Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

2.35.4 Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
2.35.5 Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.

2.35.6 Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output.

2.35.7 Specific I/O devices shall sense state of low voltage outdoor photocells.

2.35.8 Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.

2.35.9 Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).

2.35.10 Auxiliary Input/Output Devices shall be the following Sensor Switch model numbers:

- nIO D (I/O device with 0-10 dimming output)
- nIO 1S or nIO RLX (I/O device with contact closure or 0-10VDC dimming input)
- nIO NLI (Input device for detecting state of low voltage outdoor photocell; sold in nIO PKKIT only)
- nIO X (Interface device for communicating with RS-232 enabled AV Touch Screens)

2.36 Networked LED Luminaires

2.36.1 Networked LED luminaire shall have a mechanically integrated control device.

2.36.2 Networked LED luminaire shall have two RJ-45 ports.

2.36.3 Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers).

2.36.4 Networked LED luminaire shall provide low voltage power to other networked control devices.

2.36.5 System shall be able to turn on/off LED luminaire without using a relay.

2.36.6 System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).

2.36.7 System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).

2.36.8 LED Luminaires shall be the following Lithonia model families:

- RTLED
- TLED
- VLED
- ACLED
2.37 **Networked System Wall Switches & Dimmers**

2.37.1 Devices shall recess into single-gang switch box and fit a standard GFI opening.

2.37.2 Devices shall be available with zero or one integrated Class 1 switching relay.

2.37.3 Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

2.37.4 All sensors shall have two RJ-45 ports.

2.37.5 All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.

2.37.6 Devices shall be available in four colors (Ivory, White, Light Almond, Gray).

2.37.7 Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).

2.37.8 Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.

2.37.9 Devices with mechanical push-buttons shall provide tactile and LED user feedback.

2.37.10 Devices with mechanical push-buttons shall be made available with custom button labeling.

2.37.11 Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

2.37.12 Wall switches & dimmers shall be the following Sensor Switch model numbers, with device options as specified:

- **nPOD** (single on/off, capacitive touch, audible user feedback)
- **nPOD 2P** (dual on/off, capacitive touch, audible user feedback)
- **nPODR** (single on/off, one relay, capacitive touch, audible user feedback)
- **nPODM** (single on/off, push-buttons, LED user feedback)
- **nPODM 2P** (dual on/off, push-buttons, LED user feedback)
- **nPODM DX** (single on/off, single dimming raise/lower, push-buttons, LED user feedback)
- **nPODM 2P DX** (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)
- **nPODM 4P** (quad on/off, push-buttons, LED user feedback)
nPODM 4P DX (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

2.38 Networked System Graphic Wall Station

2.38.1 Ppp Device shall have a 3.5” full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.

2.38.2 Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.

2.38.3 Device shall enable user supplied .jpg screen saver image to be uploaded.

2.38.4 Device shall surface mount to single-gang switch box

2.38.5 Device shall have a micro-USB style connector for local computer connectivity.

2.38.6 Device shall have two RJ-45 ports for communication

2.38.7 Device shall be the following Sensor Switch model number:

nPODM GFX

2.39 Networked System Scene Controllers

2.39.1 Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.

2.39.2 Device shall recess into single-gang switch box and fit a standard GFI opening.

2.39.3 Devices shall provide LED user feedback.

2.39.4 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

2.39.5 All sensors shall have two RJ-45 ports.

2.39.6 Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.

2.39.7 Device shall be capable of selecting a lighting profile be run by the system’s upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).

2.39.8 Device shall have LEDs indicating current selection.

2.39.9 Scene Selector device shall be the following Sensor Switch model number:

nPODM 2S (2 Scene, push-button)
nPODM 4S (4 Scene, push-button)
nPODM 4S DX (4 Scene, push-button, On/Off/Raise/Lower)
nPODM 4L DX (4 Adjustable Presets, push-button, On/Off/Raise/Lower)

2.40 Communication Bridges

2.40.1 Device shall surface mount to a standard 4” x 4” square junction box.
2.40.2 Device shall have 8 RJ-45 ports.

2.40.3 Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.

2.40.4 Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.

2.40.5 Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.40.6 Communication Bridge devices shall be the following Sensor Switch model numbers:

nBRG 8 (8 Ports)

2.41 LIGHTING CONTROL PROFILES

2.41.1 Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

2.41.2 Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

2.41.3 All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

2.41.4 Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

2.41.5 All lighting control profiles shall be stored on the network control gateway device and on the software’s host server.

2.41.6 Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

2.41.7 Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

2.41.8 Daylight savings time adjustments shall be capable of being performed automatically, if desired.

2.41.9 Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

2.41.10 Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.42 MANAGEMENT SOFTWARE

2.42.1 Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.
2.42.2 The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).

2.42.3 The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

2.42.4 A printable network inventory report shall be available via the software.

2.42.5 A printable report detailing all system profiles shall be available via the software.

2.42.6 Software shall require all users to login with a User Name and Password.

2.42.7 Software shall provide at least three permission levels for users.

2.42.8 All sensitive stored information and privileged communication by the software shall be encrypted.

2.42.9 All device firmware and system software updates must be available for automatic download and installation via the internet.

2.42.10 Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.43 **BMS COMPATIBILITY**

2.43.1 System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.

2.43.2 BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.

2.43.3 BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.44 **SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE**

2.44.1 System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.

2.44.2 Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.

2.44.3 An “Energy Scorecard” shall be display that shows calculated energy savings in dollars, KWHr, or CO2.

2.44.4 Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).

2.44.5 Energy savings data shall be calculated for the system as a whole or for individual zones.

2.44.6 A time scaled graph showing all relay transitions shall be presented.
2.44.7 A time scaled graph showing a zones occupancy time delay shall be presented

2.44.8 A time scaled graph showing the total light level shall be presented.

2.44.9 User shall be able to customize the baseline run-time hours for a space.

2.44.10 User shall be able to customize up to four time-of-day billing rates and schedules.

2.44.11 Data shall be made available via a .CSV file

2.45 START-UP & SUPPORT FEATURES

2.45.1 To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.

2.45.2 All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

2.45.3 Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.

2.45.4 All system devices shall be capable of being given user defined names.

2.45.5 All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

2.45.6 All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel

PART 3 - EXECUTION

PRE-INSTALLATION MEETING

3.1 A factory authorized manufacturer’s representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:

3.1.1 Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.

3.1.2 Review the specifications for low voltage control wiring and termination.

3.1.3 Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.

3.1.4 Discuss requirements for integration with other trades

CONTRACTOR INSTALLATION AND SERVICES

3.2 Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs
3.3 Contractor to install all room/area devices using manufacturer’s factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturers with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer’s specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

3.4 Install the work of this Section in accordance with manufacturer’s printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

3.5 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.

3.5.1 Adjust time delay so that controlled area remains lighted while occupied.

3.6 Provide written or computer-generated documentation on the configuration of the system including room by room description including:

3.6.1 Sensor parameters, time delays, sensitivities, and daylighting setpoints.

3.6.2 Sequence of operation, (e.g. manual ON, Auto OFF, etc.)

3.6.3 Load Parameters (e.g. blink warning, etc)

3.7 Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner’s requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

FACTORY SERVICES

3.8 Upon completion of the installation, the manufacturer’s factory authorized representative shall start up and verify a complete fully functional system.

3.9 The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.

3.10 Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner’s personnel on the adjustment and maintenance of the system.

COMMISSIONING SUPPORT SERVICES

3.11 On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician’s time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent’s responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.
3.12 The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

ACCEPTANCE TESTING SUPPORT SERVICES

3.13 On all California projects, a certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Manufacturer should include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. It will be the CLCATT’s responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the CLCATT with this task.

END OF SECTION
SECTION 26 22 13

DRY TYPE TRANSFORMERS

PART 1 – GENERAL

1.1 Furnish and install where indicated on the drawings dry type transformers with voltage and phase as shown on the drawings. The transformers shall be 60 Hz with KVA rating as shown on the drawings.

1.2 Submit shop drawings and manufacturer’s data for each transformer including:

1.2.1 Incident energy level calculations

1.3 Common submittal mistakes which will result in the submittal being rejected:

1.3.1 Not including all items listed in the above itemized description.

1.3.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.3.3 Not including actual manufacturer’s catalog information of proposed products.

1.3.4 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 Acceptable manufacturers are Square D, Eaton-Cutler Hammer, Siemens or General Electric.

2.2 Equipment manufactured by any other manufacturers not specifically listed in Section 2.1 are not considered equal, or approved for use on this project.

2.3 Energy efficient transformers shall be provided in compliance with DOE 2016 standards and requirements as outlined in the California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601-1609: Appliance Efficiency Regulations and California Code of Regulations, Title 24: part 6, Subchapter 2, Sections 110-11: Building Standards. Transformers shall also meet the Class 1 Efficiency levels for distribution transformers specified in Table 4-2 of the National Electrical Association (NEMA) TP-102002, Guide for Determining Energy Efficiency for Distribution Transformers. The efficiency rating will apply to both conventional transformers and K-rated transformers.

2.4 Transformers shall comply with the latest NEMA and ANSI standards.

2.5 Transformers shall be encased in a sheet steel enclosure. Ten (10) KVA and smaller shall be non-ventilated, and above 10 KVA shall be ventilated, self-cooled. The core and coil assembly shall be completely isolated from the enclosure by means of neoprene rubber isolation pads or other acceptable vibration isolators. Transformers installed outdoors shall be provided with suitable rain shields and shall be UL listed for outdoor installation.

2.5.1 Fan cooled transformers will not be accepted.
2.6 Transformers shall have a 220 deg C insulation system with an 150 deg C average winding temperature rise above a maximum ambient temperature of 40 deg C.

2.7 Transformers shall have full capacity voltage taps consisting of the following: four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage.

2.8 Transformer cable termination compartment shall be rated at not more than 75 degrees C.

2.9 Transformers shall have aluminum windings.

2.10 Sound outputs of transformers shall not exceed the following levels, based on NEMA standard testing procedures:

<table>
<thead>
<tr>
<th>KVA Rating</th>
<th>Decibel Sound Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 9</td>
<td>40</td>
</tr>
<tr>
<td>10 - 50</td>
<td>45</td>
</tr>
<tr>
<td>51 - 150</td>
<td>50</td>
</tr>
<tr>
<td>151 - 300</td>
<td>55</td>
</tr>
<tr>
<td>301 - 500</td>
<td>60</td>
</tr>
</tbody>
</table>

PART 3 – EXECUTION

3.1 Dry type transformers larger than 112.5KVA rating shall have a minimum of twelve inches clearance between transformer ventilation openings and adjacent structure. Transformer connections shall be made with flexible conduit.

3.2 All lugs shall be torque tested in the presence of the inspector of record.

3.3 Transformers shall be anchored to the structure to resist seismic activity in accordance with Zone 4 requirements. Provide a minimum of four (4) ½-inch diameter anchor bolts for floor or roof mounted transformers.

3.4 Transformers mounted on roofs shall be installed on a roof curb. All conduits shall enter the transformer enclosure within the curbed area.

3.5 Arc Flash and Shock Hazard

3.5.1 The Contractor is to provide, and submit to the engineer for approval, incident energy level calculations as determined using the methodologies described in NFPA 70E or IEEE standard 1584-2002.

3.5.2 A warning label, as specified in the above standard, shall be placed on each switchboard, panelboard, and safety switch indicating the incident energy levels on the equipment to warn qualified personnel in accordance with NFPA 70E, section 110.16. Labels shall be laminated white micarta with black lettering on each. Letters shall be no less than 3/8" high.

3.5.3 The incident level calculations for each piece of equipment shall be given to the owner and maintained on file by the maintenance department.

3.5.4 The design goal is to minimize the incident energy to which a maintenance employee may be exposed.

END OF SECTION
SECTION 26 24 13
SWITCHBOARDS

PART 1 – GENERAL

1.1 Furnish and install service entrance and distribution switchboards as herein specified and as shown on the drawings. In order to establish the minimum acceptable quality and type of equipment described in this section, the switchboard was technically and dimensionally designed around “Square D.” If other acceptable manufacturer products listed in 2.1 are used, it shall be the responsibility of the Contractor to verify the equipment will meet the requirements of the design, both technically and dimensionally.

1.2 All electrical materials and equipment shall be new, and of the type and quality specified: Listed by Underwriters’ Laboratories, and bear their label, where standards have been established; in compliance with the applicable standards of CEC (NFPA 70), NFPA, ANSI, IEEE, IPCEA and NEMA. All components and equipment enclosures shall be manufactured by the same manufacturer.

1.3 SUBMITTALS

1.3.1 Submit shop drawings and manufacturers’ data on the switchboard and components including:

1.3.1.1 Equipment elevation diagrams indicating the bussing configurations and ampere ratings.

1.3.1.2 Coordination study and incident energy level calculations.

1.3.1.3 Metering equipment

1.3.1.4 Breakers or fused switches

1.3.1.5 Surge Protective Device (SPD)

1.4 Common submittal mistakes which will result in the submittals being rejected:

1.4.1 Not including the Short Circuit and Coordination Study with the material submittals.

1.4.2 Not including all items listed in the above itemized description.

1.4.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.4.4 Not including actual manufacturer’s catalog information of proposed products.

1.4.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acceptable manufacturers are:
2.1.1.1 Eaton
2.1.1.2 Square D
2.1.1.3 General Electric

2.2 Equipment manufactured by any other manufacturers not specifically listed in Section 2.1, are not considered equal or approved for use on this project.

2.3 Switchboards shall be of the dead front, safety type with voltage and ampere capacity as indicated. Provide a 25% minimum tin plated aluminum ground bus running the full length of the switchboards. The neutral bus shall be 100% rated throughout.

2.4 Where conductor sizes exceed the standard breaker lug wire range, or where multiple conductors per phase are required, the manufacturer shall provide the breaker with suitable lugs for terminating the specified conductors.

2.5 All bussing shall be tin plated aluminum and braced for a short circuit current of 100,000 RMS symmetrical amperes minimum, or as noted on the drawings. Horizontal and vertical bussing shall be 100% fully rated; not tapered unless otherwise noted on the drawings. All sections shall have full height bus.

2.6 The main circuit breaker (480 volt or 208 volt, 800 amp or larger) shall be a stored energy solid state trip insulated case type breaker and shall consist of a three-pole electrically and mechanically trip-free circuit breaker with inter-pole barriers, arc quenchers, manual stored-energy closing mechanism, mechanical push-button trip, position indicator, and equipped for fixed mounting in the switchboard section. Main breaker shall be 100% rated and shall be sized as indicated on the drawings. Minimum short circuit interrupting rating shall be 65,000 ampere symmetrical for all breakers in the main switchboard or as indicated on the drawings. For main breakers rated 2,500 amps and larger this rating shall be increased to 100,000 amps, or as indicated on the drawings.

2.6.1 The over current trip devices to be furnished with the main circuit breaker shall be of the three-phase construction and employ solid-state components in their design to afford combinations of long, short time, and instantaneous and ground fault characteristics (480 volt only) as specified. The circuit breaker and integral solid-state trip device shall be self-contained to include necessary power supply, transformers and tapped current level sensing transformers. An external source shall not be required to trip the circuit breaker under fault of overload conditions or to test the ground fault trip.

2.6.2 Field installed rating plug taps shall be provided.

2.6.3 Main breakers 400 amp and larger shall be solid state trip.

2.6.4 The main circuit breaker shall be provided with the following:

2.6.4.1 Adjustable longtime delay element pickup.

2.6.4.2 Adjustable short-time delay element pickup.

2.6.4.3 The instantaneous trip element pickup shall be adjustable from 1.5 to 10 times the sensor setting or none.

2.6.5 The feeder circuit breakers (480 volt or 208 volt, 400 amp or larger) shall be solid state trip molded case type breakers. They shall consist of a three-pole electrically and mechanically trip-free circuit breakers with inter-pole barriers, arc quenchers, manual closing mechanism, position indicator, and equipped for fixed mounting.
mounting in the switchboard section. The breakers shall be a minimum of 80% rated, unless otherwise identified on the drawings and shall be sized as indicated on the drawings. Minimum short circuit interrupting rating shall be 65,000 ampere symmetrical or as indicated on the drawings.

2.6.5.1 The overcurrent trip devices to be furnished with these circuit breakers shall be of the three-phase construction and employ solid-state components in their design to afford combinations of long, short time, and instantaneous and ground fault characteristics (480 volt only) as specified. The circuit breaker and integral solid-state trip device shall be self-contained to include necessary power supply, transformers and tapped current level sensing transformers. An external source shall not be required to trip the circuit breaker under fault of overload conditions or to test the ground fault trip.

2.6.5.2 Field installed rating plug taps shall be provided as required.

2.6.5.3 These circuit breakers shall be provided with the following:

- **2.6.5.3.1** Adjustable long-time delay element pickup.
- **2.6.5.3.2** Adjustable short-time delay element pickup.
- **2.6.5.3.3** The instantaneous trip element pickup shall be adjustable from 1.5 to 10 times the sensor setting.
- **2.6.5.3.4** Where the GFI function is required the settings shall be set at maximum levels.

2.7 Feeder breakers identified as 100% rating on the drawings may be molded case type below 1600 amp but 1600 amp and above shall be insulated case type. All breakers shall accept copper or aluminum conductors. Contractor must verify that the breaker can accept the possibility of aluminum conductors.

2.8 Circuit breakers less than 400 amps shall be molded case, trip free, quick-make, quick-break, thermal magnetic type, with handles clearly indicating rating and position-on, off, tripped.

2.9 Circuit breakers used in service entrance equipment, identified on the drawings shall have short circuit current ratings equal to the bracing and in no case smaller than 22,000 amperes RMS symmetrical.

2.10 The switchboard shall be manufactured to locate the utility company metering within the local utility company requirements, for maximum centerline height. This maximum height must include the 2-1/2" high (above finished grade) concrete housekeeping.

2.11 Provide a metal embossed nameplate adjacent to the switchboard rating, indicating the maximum short circuit current rating of the switchboard as determined by UL 891, September 30, 1982.

2.12 Where devices indicated are fusible type, fuses shall be Bussman or Littlefuse (no known equal).

2.13 Where a switchboard is indicated to be provided with an NEMA 3R (weatherproof) enclosure, the enclosure shall be manufactured to allow the equipment to mount flush against a vertical surface or wall. Rear roof equipment overhangs will not be permitted for weatherproof equipment.
2.14 Where auxiliary test kits or other devices are needed for setting breaker parameters they shall be supplied.

Service Entrance – Surge Protective Device


2.16 IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

2.17 IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

2.18 National Electrical Code: Article 285

2.19 UL 1283 - Electromagnetic Interference Filters

2.20 SPD shall be UL 1449 labeled as Type 1 or Type 4 intended for Type 1 applications, verifiable at UL.com without need for external or supplemental over current controls. Every suppression component of every mode, including N-G, shall be protected by internal over current and thermal over temperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of the specification

2.21 SPD shall be factory installed integral to electrical distribution equipment

2.22 SPD shall be UL labeled with 20kA I-nominal (I-n)

2.23 SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR)


2.25 SPD shall be connected to the buss of the distribution equipment with an appropriately sized 200kA SCCR rated disconnect

2.26 SPD shall meet or exceed the following criteria:

2.26.1 MAXIMUM 7-Mode surge current capability per phase shall be 400kA for mountain and desert areas with over 5 lightning strikes per year.

2.26.2 UL 1449 – Third Edition Revisions; effective September 29, 2009 Voltage Protection Ratings shall not exceed the following:

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>L-N</th>
<th>L-G</th>
<th>N-G</th>
<th>L-L</th>
<th>MCOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120</td>
<td>700V</td>
<td>700V</td>
<td>700V</td>
<td>1200V</td>
<td>150V</td>
</tr>
<tr>
<td>480Y/277</td>
<td>1200V</td>
<td>1200V</td>
<td>1200V</td>
<td>2000V</td>
<td>320V</td>
</tr>
</tbody>
</table>

2.26.3 UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com)

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Allowable System Voltage Fluctuation (%)</th>
<th>MCOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120</td>
<td>25%</td>
<td>150V</td>
</tr>
<tr>
<td>480Y/277</td>
<td>15%</td>
<td>320V</td>
</tr>
</tbody>
</table>
2.27 SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz

2.28 Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.

2.29 SPD shall include a serviceable, replaceable module.

2.30 SPD shall be equipped with the following diagnostics:

   2.30.1 Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service Led

   2.30.2 Audible alarm with on/off silence function and diagnostic test function (excluding branch)

   2.30.3 Form C dry Contacts

   No other test equipment shall be required for SPD monitoring or testing before or after installation.

   2.30.4 SPD shall have a 10 year warranty

**Short-Circuit and Coordination Studies**

2.31 The contractor shall provide the following studies; a time current and complete short-circuit study, equipment-interrupting or withstand evaluation, and a protective-device coordination study as described below for the distribution system. The equipment study shall be included with the equipment submittals. The studies shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum-fault conditions shall be thoroughly covered in the study. The studies are to be reviewed by a Professional Engineer registered in the State of California.

   2.31.1 All studies shall be performed by “Emerson Electric” (858) 695-9551, MTA (858) 472-0193, or Terra Power Solutions (858) 380-8170. Studies performed by manufactures or other engineering or testing companies must submit qualifications for approval by Johnson Consulting Engineers, 7 days prior to bid for this project.

2.32 Short-Circuit Study

   2.32.1 The study shall be in accordance with applicable ANSI and IEEE standards.

   2.32.2 The study input data shall include the short-circuit single- and three-phase contributions from all sources, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and all other applicable circuit parameters.

   2.32.3 Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.

   2.32.4 For the portions of a system utilizing medium- and high-voltage breakers, separate calculations shall be made for one-half cycle (close and latch) currents
and interrupting currents. Calculations shall be for three-phase and phase-to-ground faults at each bus under consideration.

2.32.5 For the portions of a system utilizing low-voltage breakers (less than 1,000 volts), calculations shall be made for three-phase and phase-to-ground interrupting currents at each bus under consideration.

2.33 Equipment Evaluation Study

2.33.1 An equipment evaluation study shall be performed to assure the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the maximum short-circuit momentary and interrupting duties. Series rating of over current protective devices shall be permitted to reduce the maximum available short circuit current to panelboard branch circuit breakers to no more than 10,000 amps symmetrical for the 120/208 volt system and 14,000 amps symmetrical for the 277/480 volt system.

2.34 Protective-Device Coordination Study

2.34.1 A protective-device coordination study shall be performed to select or to verify the selection of power fuse ratings, protective-relay characteristics and settings, ratios, and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and settings. Time current curves are to be colored to clearly indicate coordination.

2.34.2 The coordination study shall include all voltage classes of equipment from the source's incoming line protective device down to and including each motor control center and/or panelboard. The phase and ground over current protection shall be included as well as settings for all other adjustable protective devices. Ground fault settings are to, as a minimum coordinate with a downstream 50 amp branch circuit breaker.

2.34.3 Protective device selection and settings shall be in accordance with requirements of the National Electrical Code and the recommendations of the ANSI/IEEE Standard 399, as applicable.

2.35 Study Report

2.35.1 The results of the power-system studies shall be summarized in a final report. The report shall include the following sections:

2.35.1.1 Description, purpose, basis, and scope of the study and a single-line diagram of the portion of the power system which is included within the scope of study.

2.35.1.2 Tabulations of circuit breaker, fuse, and other equipment ratings versus calculated short-circuit duties and commentary regarding same.

2.35.1.3 Protective device coordination curves, with commentary.

2.35.1.4 The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system.
2.35.1.5 Fault-current tabulations including a definition of terms and a guide for interpretation.

2.35.1.6 The report must be submitted with the material submittal for the engineers approval.

2.36 Implementation

2.36.1 The equipment manufacturer is to be responsible for providing over current devices which are in compliance with the results of the above study.

PART 3 – EXECUTION

3.1 Switchboard shall be provided with adequate lifting means and capable of being rolled or moved directly to the floor without the use of floor sills.

3.2 Switchboard installation shall be done in accordance with National Electrical Installation Standards (NECA 400-1998) for installing and maintaining switchboards.

3.3 Provide 2-1/2" concrete housekeeping pads for service entrance and distribution switchboards. For switchboards containing local utility company metering equipment, the concrete pad must be flush with the front edge of the switchboard enclosure.

3.4 Provide permanently affixed engraved nameplate stating UL listed fault current rating of switchboard assembly. Locate adjacent to the equipment nameplate on front of switchboard.

3.5 All lugs shall be torque tested in the presence of the inspector of record.

3.6 Arc Flash and Shock Hazard

3.6.1 The Contractor is to provide, and submit to the engineer for approval, incident energy level calculations as determined using the methodologies described in NFPA 70E or IEEE standard 1584-2002.

3.6.2 A warning label, as specified in the above standard, shall be placed on each switchboard, panelboard, and safety switch indicating the incident energy levels on the equipment to warn qualified personnel in accordance with NFPA 70E, section 110.16. Labels shall be laminated white micarta with black lettering on each. Letters shall be no less than 3/8" high. The label is not to identify the party performing the study but only the technical information needed.

3.6.3 The incident level calculations for each piece of equipment shall be given to the owner and maintained on file by the maintenance department.

3.6.4 The design goal is to minimize the incident energy to which a maintenance employee may be exposed.
SECTION 26 24 16
PANEL BOARDS

PART 1 – GENERAL

1.1 Furnish and install branch circuit panel board as specified herein and as indicated on the drawings. Submit manufacturers’ data on all items.

1.2 Submit manufacturers’ data on all panel boards and components including:

   1.2.1 Enclosures and covers
   1.2.2 Breakers
   1.2.3 Surge Protective Device (SPD) equipment
   1.2.4 Incident energy level calculations
   1.2.5 Common submittal mistakes which will result in the submittals being rejected:

       1.2.5.1 Not arranging the circuit breakers in panels to match the orientations indicated on the drawings. In other words, if a 30 amp breaker is shown on the drawing in Space #2, this must be the location it appears on the submittal schedule. Standard factory arrangements will not be accepted.

       1.2.5.2 Not including all items listed in the above itemized description.

       1.2.5.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

       1.2.5.4 Not including actual manufacturer’s catalog information of proposed products.

       1.2.5.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 The interrupting rating of circuit breakers shall be 10,000 amps for the 120/208 system and 14,000 amp for 277/480 volt systems. Refer to drawings for higher interrupting rating requirements. All components and equipment enclosures shall be manufactured by the same manufacturer. Circuit breakers shall be permitted to be series rated to limit the available fault current to no more than the above ratings.

2.2 All panels shall be fully bussed. Recessed panel enclosures shall be a maximum of 20" wide and 5-3/4" deep for all panels 600 amp rated and less.

2.3 All busses shall be hand drawn copper, 98 percent conductivity and shall be located in the rear of the panelboard cabinet. Individual circuit breakers shall be bolt on type and removable from the cabinet without disturbing the bussing in any way. All panel boards shall contain ground busses.
2.4 Panel covers shall be door in door style, with one lock. Door lock shall allow access to breakers only. Access to wireways without removal of cover shall be permitted by (non removable) screws behind the locked door. Panel cover shall be provided with full length piano hinge. All locks for all panels provided in this project shall be keyed alike.

2.5 Each panel shall have a two-column circuit index card set under glass or glass equivalent on the inside of the door. Each circuit shall be identified as to use and room or area. Areas shall be designated by room numbers. Room numbers shown on the drawings may change and contractor shall verify final room numbers with the architect prior to project completion.

2.6 Tandem mounted or wafer type breakers are not acceptable.

2.7 Multiple breakers shall have one common trip handle or be internally connected. Handle ties are not acceptable.

2.8 Breaker arrangements shown in the drawings shall be maintained. The circuit breakers in panels must match the orientations indicated on the drawings. In other words, if a 30 amp breaker is shown on the drawing in Space #2, this must be the location it appears on the submittal schedule. Standard factory arrangements will not be accepted.

2.9 Where conductor sizes exceed the standard breaker lug wire range, or where multiple conductors per phase are required, the panelboard manufacturer shall provide the breaker with suitable lugs for terminating the specified conductors.

2.10 Acceptable manufacturers are Square D, Siemens or General Electric.

2.11 Equipment manufactured by any other manufacturers not specifically listed in Section 2.10 are not considered equal, or approved for use on this project.

Surge Protective Devise (SPD)


2.13 The panelboard shall be UL 67 Listed and the SPD shall be UL 1449 labeled as Type 1 or Type 2 or as Type 4 intended for Type 1 or Type 2 applications. SPD shall be factory installed integral to the panel board.

2.14 The SPD panel board shall be top or bottom feed according to requirements. A circuit directory shall be located inside the door.

2.15 SPD shall meet or exceed the following criteria:

2.15.1 For standard areas supply SPD having 100kA per phase surge current capacity. For mountain and desert areas (areas with over 5 lightning strikes per year), SPD shall have a per phase surge current capacity of 200kA.

2.15.2 UL 1449 – Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>L-N</th>
<th>L-G</th>
<th>N-G</th>
<th>L-L</th>
<th>MCOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120</td>
<td>700V</td>
<td>700V</td>
<td>700V</td>
<td>1200V</td>
<td>150V</td>
</tr>
<tr>
<td>480Y/277</td>
<td>1200V</td>
<td>1200V</td>
<td>1200V</td>
<td>2000V</td>
<td>320V</td>
</tr>
</tbody>
</table>
2.15.3 SPD shall be UL labeled with 100kA Short Circuit Current Rating (SCCR).

2.16 UL 1449 - Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>L-N</th>
<th>L-G</th>
<th>N-G</th>
<th>L-L</th>
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</tr>
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<tbody>
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<td>208Y/120</td>
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<td>700V</td>
<td>1200V</td>
<td>150V</td>
</tr>
<tr>
<td>480Y/277</td>
<td>1200V</td>
<td>1200V</td>
<td>1200V</td>
<td>2000V</td>
<td>320V</td>
</tr>
</tbody>
</table>

2.17 SPD shall be UL labeled with a minimum 100kVA short circuit rated (SCCR).

2.18 UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Allowable System Voltage Fluctuation (%)</th>
<th>MCOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120</td>
<td>25%</td>
<td>150V</td>
</tr>
<tr>
<td>480Y/277</td>
<td>15%</td>
<td>320V</td>
</tr>
</tbody>
</table>

2.19 SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz. No filtering is required for a 100kA SPD.

2.20 Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.

2.21 Type 4 SPD shall include a serviceable, replaceable module.

2.22 SPD shall be equipped with the following diagnostics:

2.22.1 Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.

2.22.2 No other test equipment shall be required for SPD monitoring or testing before or after installation.

2.23 SPD shall have a response time no greater than 1/2 nanosecond

2.24 SPD shall have a 10 year warranty

2.25 The SPD panelboard shall have removable interior

2.26 The SPD panelboard main bus shall be aluminum and rated for the load current required

2.27 The SPD panelboard shall include a 200% rated neutral assembly with copper neutral bus

2.28 The unit shall be provided with a safety ground bus

**SPD Quality Assurance**

2.29 Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.

2.30 Manufacturer shall be ISO 9001 or 9002 certified.

2.31 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
2.32 The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

PART 3—EXECUTION

3.1 Painting of panelboard covers in finished areas shall be done by the general contractor.

3.2 Provide a spare 3/4” conduit stubbed to an accessible area for each of every three (3) spares or spaces provided in recessed panel boards.

3.3 All lugs shall be torque tested in the presence of the inspector of record.

Arc Flash and Shock Hazard

3.4 The Contractor is to provide, and submit to the engineer for approval, incident energy level calculations as determined using the methodologies described in NFPA 70E or IEEE standard 1584-2002.

3.4.1 All studies shall be performed by “Emerson Electric” (858) 695-9551, MTA (858) 472-0193, or Terra Power Solutions (858) 380-8170. Studies performed by manufacturers or other engineering or testing companies must submit qualifications for approval by Johnson Consulting Engineers, 7 days prior to bid for this project.

3.5 A warning label, as specified in the above standard, shall be placed on each switchboard, panelboard, and safety switch indicating the incident energy levels on the equipment to warn qualified personnel in accordance with NFPA 70E, section 110.16. Labels shall be laminated white micarta with black lettering on each. Letters shall be no less than 3/8” high.

3.6 The incident level calculations for each piece of equipment shall be given to the owner and maintained on file by the maintenance department.

3.7 The design goal is to minimize the incident energy to which a maintenance employee may be exposed.

END OF SECTION
PART 1 – GENERAL

1.1 Furnish and install all wiring devices as shown on drawings and as herein specified. Unless otherwise noted, device and plate numbers shown are Hubbell and shall be considered the minimum standard acceptable. Other acceptable manufacturers are Pass and Seymour, Leviton, General Electric and Bryant.

1.2 Submit manufacturers’ data on all items.

1.3 **Common submittal mistakes which will result in the submittals being rejected:**

   1.3.1 Not correctly indicating ampacity rating of proposed devices.

   1.3.2 Not including all items listed in the above itemized description.

   1.3.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

   1.3.4 Not including actual manufacturer’s catalog information of proposed products.

   1.3.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 All light switches and receptacles shall be manufactured by Cooper Wiring Devices, Hubbell Inc., Leviton Manufacturing Corp., or Pass & Seymour.

2.2 All switches shall be of the quiet mechanical type, Specification Grade, 20 amp, 120/277 volt AC as follows:

<table>
<thead>
<tr>
<th></th>
<th>HUBBELL</th>
<th>LEVITON</th>
<th>PASS &amp; SEYMOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Pole</td>
<td>CS120</td>
<td>CS1202</td>
<td>CS20AC1</td>
</tr>
<tr>
<td>Two Pole</td>
<td>CS1222</td>
<td>CS2202</td>
<td>CSB20AC2</td>
</tr>
<tr>
<td>Three-way</td>
<td>CS320</td>
<td>CS3202</td>
<td>CS20AC3</td>
</tr>
<tr>
<td>Key Switch</td>
<td>HBL1221L</td>
<td>1221-2L</td>
<td>PS20AC1-L</td>
</tr>
</tbody>
</table>

2.3 All switches shall have the "on" and the "off" position indicated on the handle. If switches of higher ampere ratings are required, they shall be of similar type and quality as those shown above. Groups of switches shown at one location shall be installed under a single plate up to a maximum of six where more than six switches are shown coordinate arrangement with the Architect.

2.4 Dimmer switches for incandescent lamp loads shall be square-law type, slide control dimmer with OFF position, Lutron or Hubbell "Nova-T" Series NT-600 (0-500 watt load), NT-1000 (501-900 watt load), NT-1500 (901-1500 watt load), or equal (no known equal).

2.5 All convenience receptacles and special outlets throughout shall be grounding type. Convenience receptacles shall be side wired, parallel slot, two pole, three wire, 20 amp as follows:
<table>
<thead>
<tr>
<th>Duplex</th>
<th>HUBBELL</th>
<th>LEVITON</th>
<th>PASS &amp; SEYMOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFCI</td>
<td>GFR5362</td>
<td>7899</td>
<td>2097</td>
</tr>
<tr>
<td>Isolated Ground</td>
<td>IG5362</td>
<td>5362IG</td>
<td>IG6300</td>
</tr>
<tr>
<td>Tamper Proof</td>
<td>8300SG</td>
<td>TR63H</td>
<td></td>
</tr>
</tbody>
</table>

2.6 All safety or tamper proof receptacles shall have no exposed external current carrying metal parts, and shall have integral wiring leads suitable for two or three wire installations.

2.7 Special receptacles shall be as noted on the drawings.

2.8 Weatherproof plates shall be designed to meet CEC Article 410-57, wet location listed with cover "open." Where weatherproof receptacles have been identified to be provided with locking covers, the cover shall be as manufactured by Pass & Seymour #4600-8 or Cole Lighting 310 Series. Rough-in requirements vary between manufacturers. Contractor to field verify requirements prior to installation.

2.9 All plates throughout shall be stainless steel. Where wiring devices are installed in concrete block walls, provide oversized 3-1/2" x 5" coverplates.

2.10 All devices shall be white unless otherwise noted or a special purpose outlet.

2.11 Unless where specifically detailed on the drawings, floor boxes shall be PVC suitable for concrete poured floors of minimum 3-1/2" depth, with a modular design to gang two or three sections together.

2.11.1 Carlon #E976 series or approved equal

2.11.2 Provide brass cover with brass carpet flange unless otherwise detailed.

PART 3 – EXECUTION

3.1 Switches for room lighting shall be located no more than 12" center line from door jamb at plus 48" center line above finished floor or +46" to top of devices where located over casework, reference CBC Figure 11B-5D.

3.2 All receptacles shall be mounted at plus 18" to center line above finished floor unless noted or shown otherwise. All receptacles shall be installed with the ground pin up, at the top of the receptacle to comply with IEEE 602-1986.

3.3 Furnish and install wall plates for all wiring devices, and outlet boxes, including special outlets, sound, communication, signal, and telephone outlets, etc. as required. All cover plates shall be appropriate for type of device.

END OF SECTION
SECTION 26 28 16
DISCONNECTS

PART 1 – GENERAL

1.1 Furnish and install all disconnect switches as shown on the drawings and as required by the CEC.

1.2 Submit manufacturers’ data for all disconnects and fuses.

1.2.1 Disconnects

1.2.2 Fuses

1.3 Common submittal mistakes which will result in the submittals being rejected:

1.3.1 Not including all items listed in the above itemized description.

1.3.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.3.3 Not including actual manufacturer’s catalog information of proposed products.

1.3.4 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

2.1 Acceptable manufacturers shall be Square D, Siemens or General Electric.

2.2 Equipment manufactured by any other manufacturers not specifically listed in Section 2.1 are not considered equal or approved for use on this project.

2.3 All switches shall be heavy-duty type, externally operated, quick-make, quick-break, rated 600 volts or 240 volts as required, with the number of poles and ampacity as noted. All switches for motors shall be HP rated. Switches shall have NEMA-Type 1 enclosures, except switches located where exposed to outdoor conditions shall have NEMA Type 3R enclosure. Switches generally shall be fused except where noted to be non-fused on the drawings.

2.4 Where fuses are indicated, fuses shall be Cooper Bussman, Edison Fuse Inc., Ferraz Shawmut Inc., or Littlefuse. Fuses shall be current limiting type with time delay characteristics to suit the equipment served.

PART 3 – EXECUTION

3.1 Mount all switches to structure or U-channel support. U-channel supports shall be cleaned and painted to prevent rust.

3.2 Switches shall be accessible with proper clearances in front per CEC 110-16.

3.3 All lugs shall be torque tested in the presence of the inspector of record.
3.4 Arc Flash and Shock Hazard

3.4.1 The contractor is to provide, and submit to the engineer for approval, incident energy level calculations as determined using the methodologies described in NFPA 70E or IEEE standard 1584-2002.

3.4.2 A warning label, as specified in the above standard, shall be placed on each switchboard, panelboard, and safety switch indicating the incident energy levels on the equipment to warn qualified personnel in accordance with NFPA 70E, section 110.16. Labels shall be laminated white micarta with black lettering on each. Letters shall be no less than 3/8" high.

3.4.3 The incident level calculations for each piece of equipment shall be given to the owner and maintained on file by the maintenance department.

3.4.4 The design goal is to minimize the incident energy to which a maintenance employee may be exposed and in no case more than 8 cal./cm².

END OF SECTION
PART 1 – GENERAL

1.1 Furnish and install an uninterruptible emergency lighting Inverter System and Emergency Power Control Relays to provide a reliable source of emergency power, designed to operate during periods of utility line deficiencies without any interruption in power supplied to the connected load. The system shall provide and be capable of powering any combination of electronic, power factor corrected, fluorescent, incandescent or HID lighting. Other connected loads shall include but not be limited to building management systems, motors, security systems and other critical voltage or frequency-sensitive electronic loads. The system shall operate from 0-100% loading and be rated to deliver full KVA rated output at unity power factor for a minimum of 90 minutes. Upon return to normal AC utility line power, the system shall recharge the batteries without any interruption of power supplied to the load.

1.2 The Inverter System shall be listed to or comply with these standards:

1.2.1 UL 924 Standard for Emergency Lighting and Power Equipment

1.3 The Emergency Power Control Relay shall comply with UL 924

1.4 Submit Manufacturers’ data sheets for all components including:

1.4.1 Warranty

1.4.2 Wiring diagrams

1.4.3 Bill of materials.

1.4.4 Product catalog sheets or equipment brochures.

1.4.5 Product guide specifications.

1.4.6 Installation information, including weights and dimensions.

1.4.7 Drawings for requested optional accessories.

1.5 Common submittal mistakes which will result in the submittals being rejected:

1.5.1 Not including all items listed in the above itemized description.

1.5.2 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining, or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.5.3 Not including actual manufacturer’s catalog information of proposed products.

1.5.4 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.
PART 2 - PRODUCTS

Single Phase systems 2000VA or less

2.1 Emergency Lighting Equipment shall be manufactured by Chloride Systems, Cooper Industries Inc., Dual-Lite or Hubbell Inc.

Single Phase systems 2000VA or less

2.2 The Central Inverter System specified herein shall be:

2.2.1 Dual Lite “Synchron” Series Inverter System.

2.2.2 Alternate manufacturers shall comply with these specifications, and shall not exceed the physical dimensions and weights indicated on the drawing schedule.

Single Phase systems over 2000VA

2.3 The Central Inverter System specified herein shall be:

2.3.1 Dual Lite “Spectron LSN” Series Inverter System.

2.3.2 Alternate manufacturers shall comply with these specifications, and shall not exceed the physical dimensions and weights indicated on the drawing schedule.

2.3.3 Equipment as manufactured by Digital Signal Power Manufacturer (DSPM) has been reviewed and is not an approved alternate for this project.

2.4 System operation shall be fully automatic. The charging system will maintain the batteries at full capacity at all times. On-board microprocessors will continuously monitor charger settings and the system's overall readiness. Diagnostic circuitry shall include a software controlled charger, continuous monitoring of operating parameters, and programmable system testing capabilities. Individual alarms and system logs shall be provided. All alarms and logs shall be automatically recorded and readily displayed via the User Interface Display (UID). The system shall also include one RS232 serial port for remote communications.

2.5 Automatic overload and short circuit protection in normal and emergency mode shall consist of 150% momentary surge capability, 120% overload for 5 minutes, and 110% overload for 10 minutes. Protection shall also include a low battery voltage disconnect, AC input circuit breaker, a DC input breaker or Fuse, and an AC output fuse. A digitally generated sinusoidal output waveform (PWM) with less than 5% total harmonic distortion at rated linear load shall be provided to the connected load.

2.6 Available input voltage shall be as indicated on the drawings, with a frequency of 60Hz. The AIC rating shall be a minimum of 42,000 RMS symmetrical amperes.

2.7 Available output voltage shall be as indicated on the drawings, with a frequency of 60Hz + 0.05Hz.

2.8 The user interface display (UID) shall include an array of LED’s, a 2-line, 40-character LCD display, and a keypad for system input. The UID shall be menu-driven and display individual system parameters using a numbered code (Hot Key). The LED array shall indicate, by color code, the following status modes:
2.8.1 AC output presence (green)
2.8.2 System ready (green)
2.8.3 Battery charging (red)
2.8.4 Inverter “ON” (amber)
2.8.5 Alarm functions (red)

2.9 To ensure only authorized personnel have system access, a multi-level password shall be required to change all functions and operating parameters. A continuous scrolling display of the following metered functions shall be provided:

2.9.1 AC input voltage, AC output voltage, AC output amps
2.9.2 Battery voltage, Battery charging amps, Battery discharge amps
2.9.3 Output volt-amps (VA), Output power (watts)
2.9.4 Ambient temperature
2.9.5 Last inverter run time, Total inverter run time, System run time, Date Time

2.10 Audible and visual alarms shall be provided, with automatic logging of the twenty-five most recent events. An alarm acknowledgment feature shall be provided, which will allow the user to silence only the current audible alarm without silencing other alarms or clearing the alarm condition until the fault has been addressed. An alarm shall be sounded if any of the following operating conditions occur:

2.10.1 Low battery voltage, Near low battery voltage, High battery voltage
2.10.2 High AC input voltage, High AC output voltage, Low AC output voltage Output, overload (VA), Low remaining run time
2.10.3 High ambient temperature
2.10.4 Tripped circuit breaker

2.11 Manual and automatic test modes shall be provided.
2.11.1 Manual user-initiated system test at any time.
2.11.2 Automatic monthly and annual self-diagnostic tests.
2.11.3 Automatic recording of the last twenty events in a Test Results log.

2.12 A three-step float charger shall be software controlled and temperatures compensated, and charge the batteries continuously while in normal “standby” condition (non emergency mode). Following a power failure, the constant current charger mode shall be initiated until battery voltage reaches the equalize stage. Equalize stage shall be maintained until the charging current drops to .5 amps, or 0.3% of the battery amp/hour rating. Battery voltage shall then enter the float stage.
2.13 Batteries shall be designed to provide a minimum 1.5 hours rated output voltage to the connected load in emergency mode without dropping below 87.5% of nominal battery voltage.

2.13.1 The batteries shall be encased in an enclosure that permits easy maintenance without requiring removal.

2.13.2 Sealed Lead Calcium: Maintenance Free Construction requires no addition of water over its useful. Life expectancy is 10-years at 77°F (25°C) ambient temperature.

2.14 The following optional factory-installed equipment shall be provided:

2.14.1 Normally-On Output Circuit Breaker Options:

2.14.1.1 A maximum of fourteen monitored positions are available. Single pole 120V and 277V breakers occupy one position each, while double pole 240V breakers occupy two positions. Reference drawings for required number of output breakers required.

2.14.2 Provide Universal cabinet locks for all electronic and battery cabinets.

2.14.3 Provide, using the system’s RS232 port, a fax operating status reports is transmitted over a customer-supplied dedicated analog phone line to up to six locations. Phone numbers can be programmed locally using the unit keypad or computer terminal, or remotely via a modem. Each designated fax location automatically receives a unit status report following monthly and annual tests, or when an alarm condition is detected. Status reports include readings on key operating parameters, as well as complete alarm and inverter log printouts, in uncoded, user-friendly descriptions. This option also provides for two-way communications thru terminal emulation software, such as HyperTerminal (not supplied with the inverter system).

2.14.4 Provide a factory-installed, internally-mounted two-position “make before break” switch. Compatible with all input/output combinations and any combination or quantity of output circuit breakers. Allows connecting the utility power supply to the load without placing the inverter in emergency mode.

2.15 Maintenance, Service and Enhanced Warranty Plans. The following shall be provided to assure initial and long term viability of the system through additional maintenance and service plans and/or through enhancements to the standard two-year electronics limited warranty.

2.15.1 Factory Start-Up shall be supplied as a service to the installing contractor. The Factory Start-Up process shall verify correct installation and operation of the inverter system. Trained, factory authorized technicians shall administer an on-site, point-by-point check of the system to include:

2.15.1.1 Internal electrical connections

2.15.1.2 AC input and Battery connections

2.15.1.3 System operating voltages

2.15.1.4 System operating parameters
2.15.1.5 Initial system "power-up

2.15.1.6 Battery discharge test

2.15.1.7 Correction of existing deficiencies

2.15.1.8 Final testing, calibration and recording

2.15.1.9 Training of available operating personnel

2.15.2 A Monitoring Program shall provide for the continuous monitoring of the inverter system by the Factory Technical Support Group. All monthly and annual system tests shall be reviewed and analyzed for early warning signs of system malfunction. Any failures shall be automatically relayed to the service department where corrective action can be recommended to the owner/operator. For activation, a user supplied dedicated analog phone line must be available.

2.15.3 Preventive Maintenance Plan (PMP) - The Preventive Maintenance Plan shall provide system coverage beyond the standard two-year factory warranty. PMP warranty service excludes the batteries, which are covered under a separate warranty plan. Installation of a Fax Modem option shall be provided for Preventive Maintenance Plan.

2.15.3.1 Additional 2-year warranty and 2-year service coverage, weekdays, Monday-Friday, 8AM to 5PM EST. If the standard factory warranty has expired before selection and purchase of a PMP plan, an on-site evaluation shall be scheduled to determine if the system requires parts and/or labor to return to factory specifications. Parts and labor required shall be charged at additional costs.

2.16 The system shall be contained in a code gauge, steel NEMA 1 enclosure, finished in a scratch resistant, powder coat finish, with a key lock, conduit knockouts at the top and sides, and front opening doors. Enclosures shall be designed to allow stacking to minimize the overall system’s footprint. All components shall be front accessible and incorporate a modular design and a quick disconnect means to facilitate servicing.

Emergency Power Control Relays - (Noted on the drawings as LVS EPC Control relay)

2.17 Insert Series power control modules are designed to allow locally switched lighting fixtures to be wired for emergency operation from either generator, inverter system, or secondary sources.

2.18 As Manufactured by:

2.18.1 "Highlights" HEPC Series Emergency Power Control modules (203) 575-2044 www.highliteslighting.com

2.18.2 LVS Controls (800) 982-4587 www.lvscontrols.com

2.19 During normal operation, LEDs on the module’s faceplate indicate the presence of both utility (Green) and emergency (red) power and the local switch will be capable of turning all circuit lighting fixtures on or off as required. During utility power failures, emergency lighting fixtures controlled by the module will illuminate regardless of local switch position. If, during normal operation, emergency backup power is lost, the module will automatically produce an audible alarm as an alert to this potentially hazardous condition.
Recent energy mandates require improved vigilance in the conservation of resources. By eliminating the need for night light circuits, power controls conserve energy by allowing all area ambient lighting to be turned off while still assuring the availability of emergency illumination in the event of a utility power failure.

The power control automatically initiates a test of the emergency lighting fixtures whenever the local switch is turned off. Upon turning off of the local switch, the designated emergency lighting fixtures will remain illuminated for an additional 5 seconds to assure system readiness. The power controls may also be checked manually at any time through the integral test switch provided on the module’s faceplate. With the local lighting turned off and both utility and emergency power present, pressing the test switch will cause the controlled emergency fixtures to illuminate for 5 seconds.

Adapts locally switched lighting fixtures for emergency operation, bypasses local switch during power failures. Compatible with motion detector and photocells.

Full 20 amp load capability available for 120 or 277VAC operation. Approved for in-wall or in-ceiling applications.

Provided with Surge and short circuit protection.

Audible emergency power circuit failure alarm, Built-in manual emergency circuit test feature, Momentary test switch.

Provide a single module at each emergency lighting fixture where the lighting fixture is locally controlled by a room switch and or motion sensor. These modules are to be furnished and installed by the contractor installing the lighting fixtures.

Provide a single module located at the panelboard or low voltage control panel to control emergency lights controlled from a low voltage control system. These modules are to be furnished and installed by the contractor installing the lighting fixtures.

Where dimmable light fixtures are on emergency circuit, provide emergency relay control which is dimming compatible, and will bring lights to full brightness in emergency mode.

The Module has a full 5-year replacement warranty.

PART 3- EXECUTION

Input and output conductors shall be enclosed in separate conduits. All load side wiring shall be sized as required for voltage drop conditions to assure proper operation of connected loads.

All free standing electrical equipment or enclosures shall be anchored to the floor and braced at the top of the equipment to the structure. Where details have not been provided on the drawings, anchorage shall comply with CBC Section 1632A and Table 16-A0. The Contractor shall submit drawings signed by the Contractors registered structural Engineer indicating method of compliance prior installation.

The system shall allow connection of both "normally on" and "normally off" (optional) loads. Connected loads shall receive utility power during normal operation, and “no break” system inverter power during utility interruptions.

In emergency mode, the inverter system shall supply true digitally-generated AC sinusoidal output. Refer to plans for type and location of loads served by the system.
3.5 A factory trained service representative shall be dispatched to perform the initial system start-up.

3.6 Documents supplied with each system shall include:

3.7 Shop drawings showing physical dimensions, mounting information and wiring diagrams.

3.7.1 Installation/Users manual(s) for locating, mounting, interconnecting, and wiring the system, with operating and preventive maintenance procedures.

3.7.2 The system shall be installed in accordance with all appropriate manufacturers' instructions and in compliance with all appropriate codes.

3.8 The system shall be guaranteed, under normal and proper use, against defects in workmanship and materials for a period of two years from the date of shipment. Batteries supplied as part of the systems shall be covered under a separate pro-rata warranty as described below:

3.8.1 Sealed Lead Calcium, 10-year life expectancy – One-year full replacement warranty plus an additional nine years pro-rata.

3.8.1.1 Note: Within 90 days from date of shipment, batteries shall be connected to an energized charging system to maintain the Warranty. Battery life and capacity is rated at an optimum operating temperature range of 68°F to 85°F. Operating temperatures outside this range will affect battery life and capacity. Batteries are rated at 100% capacity at 77°F.

3.9 Maintenance and service programs shall be made available by the supplier to assure long-term reliability of the system.

END OF SECTION
SECTION 26 51 14

LED LIGHTING FIXTURES AND LAMPS

PART 1 – GENERAL

1.1 Furnish and install all lighting fixtures with lamps as specified and as shown on the drawings. Fixtures shall be complete including canopies, hanger, diffusers, ballasts, etc.

1.2 Submit manufacturer's data for each fixture type including the following:

1.2.1 Lighting fixture catalog data and photometry.
1.2.2 Lamp catalog data for each fixture type.
1.2.3 Driver catalog data for each fixture type.
1.2.4 Fixture warranty.

1.3 **Common submittal mistakes which will result in the submittal being rejected:**

1.3.1 Not including lamp and driver information for each fixture type.
1.3.2 Not including all items listed in the above itemized description.
1.3.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.
1.3.4 Not including actual manufacturer’s catalog information of proposed products.
1.3.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

PRODUCT SUBSTITUTION

1.4 All substitutions or alternate fixtures to those indicated on the project fixture schedule shall be submitted for approval (7) business days prior to the project bid date. Approvals when accepted will be issued in the form of an addendum. No consideration for substitutions will be provided after the award of the contract.

1.4.1 The substitution request must include a statement indicating the difference in price of both the specified and alternate product, both contractor and list price. The substitution request must include a comparison of the total fixture wattage, total fixture lumens, fixture efficiency and warranty comparison.

1.4.2 When proposing to substitute lighting fixture and/or fixture retrofit, a point by point photometric calculation of a typical application as used in this project shall be included. A calculation of the specified and the proposed alternate shall be included.

PART 2 – PRODUCTS

2.1 All catalog numbers are given for manufacturer's identification and shall not relieve Contractor from responsibility of full conformance to all applicable written description requirements governing material and fabrication, either in the general or specific sections. Where catalog numbers are indicated as modified, no modification will be required if the standard unit fully conforms to descriptive requirements in the Specifications and matches specified ceiling.
2.2 All fixtures of the same type shall be of one manufacturer and of identical finish and appearance. All fixtures and component parts shall bear the UL label.

2.3 All steel parts shall be phosphate treated in multistage power spray system for corrosion resistance and paint adhesion. Final finish shall be electrostatically applied baked white enamel of not less than 87 pct. reflectance on reflecting surfaces.

2.4 Each fixture shall have a continuous light-seal gasket seated in such manner as to prevent any light leak through any portion or around any edge of the trim frame.

2.5 Diffusers shall be framed in a hinged, continuous assembly. Diffuser frame latches shall be spring-loaded or cam-operated.

2.6 All recessed fixtures shall be provided with frames appropriate for the type of ceiling involved. No fixtures shall be ordered until the ceiling construction has been verified by the Contractor.

MINIMUM LUMINARY REQUIREMENTS

2.7 Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.

2.8 Recessed Fixtures: Comply with NEMA LE 4.

2.9 CRI of minimum 80 CCT of 4000 K.

2.10 Rated lamp life of 50,000 hours minimum.

2.11 Lamps dimmable from 100 percent to 0 percent of maximum light output.

2.12 Nominal Operating Voltage: 120 V / 277 V ac

PART 3 – EXECUTION

3.1 All lighting fixtures shall be supported as follows:

3.1.1 From the outlet box by means of a metal strap where its weight is less than five pounds.

3.1.2 From its outlet box by means of a hickey or other threaded connection where its weight is from five to fifty pounds.

3.1.3 Directly from the structural slab or joists where its weight exceeds fifty pounds.

3.1.4 Lighting fixtures shall be supported independent of the ceiling system or additional ceiling support must be added to carry the weight of the lighting fixtures. Recessed lighting fixtures supported from ceiling grid tees shall be furnished with hold down clips in conformance with CEC 410 - 16, spring clips will not be permitted. All fixtures which the manufacturer has not provided UL approved clips, must be attached to the fixture and ceiling grid by metal screws.

3.2 Furnish and install supplementary blocking and support as required to support fixture from structural members. Contractor shall submit proposed blocking method for all suspended lighting fixtures for approval prior to rough in.

3.3 Suspended and/or pendant mounted fixtures shall be provided with four aircraft safety cables extending in opposite directions, attached to the fixture, and supported from a
structural member. The contractor shall submit proposed fixture mounting and aircraft cable attachment methods for approval prior to fixture rough in.

3.4 Class 1 wiring to the fixture must be installed in conduit, no open wiring shall be permitted.

3.5 Chain suspension may be used only where specifically permitted on the drawings. Chain shall be heavy duty, nickel or cadmium plated, suitable for weight of specific fixture.

3.6 Shop drawings shall be furnished for each fixture type. Catalog cuts, illustrating conformance with specifications, will be acceptable for standard units. Shop drawings shall indicate materials, assembly, finish and dimensions.

3.7 Photometric data shall be furnished for any fixture substituted for those listed on the schedule.

3.8 Any driver which produces a greater than normal amount of noise shall be replaced by the contractor. Normal will be determined by the level of sound produced by other similar fixtures operating in the area.

END OF SECTION
SECTION 26 90 90

TESTING

PART 1 – GENERAL

1.1 Upon completion of the electrical work, the entire installation shall be tested by the Contractor, and demonstrated to be operating satisfactorily to the Architect, Engineer, Inspector and Owner.

1.2 All testing and corrections shall be made prior to demonstration of operation to the Architect, Engineer, Inspector and Owner.

1.3 In addition to the demonstration of operation, the Contractor is also required to review the content and quality of instructions provided on items demonstrated with the Architect, Engineer, Inspector and Owner.

PART 2 – EXECUTION

2.1 Wiring shall be tested for continuity, short circuits and/or accidental grounds. All systems shall be entirely free from “grounds,” “short circuits,” and any or all defects.

2.2 Motors shall be operating in proper rotations, and control devices functioning properly. Check all motor controllers to determine that properly sized overload devices are installed, and all other electrical equipment for proper operation.

2.3 Tests and adjustments shall be made prior to acceptance of the electrical installation by the Architect, and a certificate of inspection and acceptance of the electrical installation by local inspection authorities shall be provided.

2.4 All equipment or wiring provided which tests prove to be defective or operating improperly shall be corrected or replaced promptly, at no additional cost to the Owner.

2.5 Test all motor and feeder circuits with a “megger” tester to determine that insulation values conform to Section 110-20, California Electrical Code (CED). Test reports must be submitted and approved by the engineer before final acceptance.

2.6 Test all grounding electrode connections to assure a resistance of no more than 10 ohms is achieved. Augment grounding until the ohmic value stated above is achieved. Provide certified test results to the Architect, Engineer and Inspector.

END OF SECTION
ARTICLE 1 - SUMMARY

1.1 This Division of the specifications outlines the provisions of the contract work to be performed as a sub contract under the Division 26 scope of work. Reference the Division 26 Electrical General Provisions for scope of work and general requirements.

1.2 In addition, work in this Division is governed by the provisions of the bidding requirements, contract forms, general conditions and all sections under Division 1 requirements.

END OF SECTION
PART 1 – GENERAL

1.1 Include all labor, equipment and materials necessary for providing a complete networking infrastructure system as described herein and/or as indicated on the drawings.

1.2 Related specification sections:

1.2.1 Section 26 01 00 - General Provisions
1.2.2 Section 26 05 19 - Conductors
1.2.3 Section 26 05 33 - Conduit and Fittings
1.2.4 Section 26 05 34 – Outlet and Junction Boxes

1.3 Approved minimum Product and Contractor Extended Warranty Certifications;

1.3.1 All components shall be manufactured by one of approved manufacturers, the installing Contractor must have the accompanying certification from the product manufacturer(s) for installation of a “Extended Warranted System” as required by each manufacturer and as indicated in these specifications.

1.3.1.1 Specified system warranties are to be established between the component and cable manufacturers and the District, warranties between the cable manufacturer only or installing Contractor and the District are not considered equal.

1.3.1.2 Warranty shall be a full “Performance Warranty” installed by a “Certified Contractor” as specified by one of the approved manufacturers. A “Component Warranty” will not be considered equal. All components, labor, and “Performance Criteria” shall be warranted by one of the approved manufacturers;

1.4 Acceptable manufacturers are:

1.4.1 BELDEN

1.4.1.1 Installing Contractor must be Certified BELDEN PartnerAlliance “CSV” Networking Contractor to provide installation of this system.

1.4.1.2 Warranty provision and training must be for the 25-Belden Certified Networking System Premium Performance Warranty Program with the Lifetime Application Assurance Program. Warrantied installation and Belden “Lifetime” follow-up support shall be furnished with the Contractors bid.

1.4.2 SUMITOMO

1.4.2.1 Installing Contractor must be a Sumitomo FutureFlex Air-Blown Fiber Certified Installation Contractor to provide installation of the fiber optic distribution system for the data infrastructure.

1.4.3 Warranty shall be to the District for the period as defined by the Network Infrastructure System Warranty, after District acceptance and sign-off of the completed system. The Contractor must provide documentation from the approved manufacturer indicating their qualifications for installation of this system.
1.4.4 Equipment qualifications: It is the intent of these specifications that each bidder provides all hardware, components and installation services that are necessary to ensure a fully operational wiring system including warranties, as shown in the EIA/TIA Category-6 guidelines.

1.4.5 All components, parts, infrastructure, patch cables, termination panels and cables must be classified by the manufacturer or manufacturers as a part of the “Extended Warranty” program. Contractor may not mix in components from other certified programs or materials that are not considered part of the “25 year” warranty.

1.4.6 Systems or components as manufactured by any other manufacturer which are not specifically listed are not approved for use on this project. Where it is specified that a system be provided by “manufacturer #XXX or “equal” a substitution of other manufacturers products will only be considered for a complete end to end solution of equal quality as determined by the Project Engineer. All substitutions shall conform to the substitution requirements detailed in the specifications. Where these specifications do not include the statement “or equal” for an individual material component or system, substitutions will not be considered.

1.5 Installer to provide a warranty for one year from Notice of Completion on all materials and workmanship (labor) installed or supplied as part of the Data Infrastructure System.

1.6 Installing Contractor qualifications: Firms and their personnel must be regularly engaged in the installation of data networking cabling and equipment for systems of similar type and scope. The Contractor must have a full-service office able to respond to emergency callouts during the warranty period. The Contractor must also provide complete installation of all wiring and devices or equipment. Subcontracts with Electrical Contractors or other warranted or non-warranted Contractors for supervised installation of any part of this system are not approved.

1.6.1 Contractor shall have on staff a minimum of (1) BICSI RCDD on staff as full-time employees.

1.6.2 The successful Contractor shall be a California licensed C7 Premise Wiring Contractor or C10 Electrical Contractor as defined in this specification.

1.6.3 All work shall be performed under the supervision of a company accredited and trained by the Manufacturer of the components and cable and such accreditation must be presented with the bid submittal. All personnel performing work on this project must have successfully completed the manufacturer’s training courses to completely comply with the extended warranty requirements prior to performance of any work on this project. Accreditation will consist of individual employee certifications issued by the manufacturer or manufacturers.

1.6.4 Submit for approval records regarding the management, installation and testing personnel. These records shall include resumes, training certificates, previous work experience details (especially on reference projects) and other relevant information. Submit records to confirm that the personnel who will be employed in an installation capacity are suitably trained in the installation and maintenance of equipment and systems of the type being provided.

1.6.5 Contractors Supervising Project Manager in charge of the installation of the Networking Infrastructure System must possess a Belden Systems Design (ENT303) Certification, Belden Project Management (ENT201) Certification, Copper & Fiber Certification for Project Manager (#702) Certification and the
installer’s (#703) Certification.

1.6.6 Contractor’s on-site Lead Foreman supervising the installation of the Network Infrastructure System must possess a Copper & Fiber Certification for Project Managers (#702) Certification plus the Installer’s Certification.

1.6.7 Contractor’s on-site Installers providing installation of the Network Infrastructure System must possess a Copper & Fiber Installation course (#703) Certification for Installers.

1.6.8 All personnel engaged in the testing of premises fiber optic and copper UTP cable systems must have successfully completed the test equipment manufacturer’s training courses. Certification of such training must be presented with the bid submittal. Cut sheets of the test equipment to be utilized shall be provided with the Phase I project material submittals.

1.6.9 These submittals are required to ensure that the Certified Management and Installation Personnel are able to carry out all work in a competent manner. Failure to produce satisfactory training documentation may result in the bid being deemed non-compliant.

1.6.10 If Contractor routes cables and/or associated pathways in another route than indicated on the drawings, they shall maintain all maximum cable installation distances as required by the manufacturer’s distance limitations.

1.7 Contractor References:

1.7.1 Submit for approval, references for a minimum of three similar projects successfully completed within the last three years. These projects should be similar to the project being bid.

1.7.2 Provide project name, address, contact name and telephone number and construction manger name and telephone number. Provide a brief description of each project indicating types of system installed, quantities and configurations of outlets and project time scale.

1.7.3 At least two of the references shall be located in Southern California and available for the Owners Representative and other members of the Design Team to visit and inspect the installation should the Owners Representative feel it necessary.

1.7.4 These references are intended to show that the installer has successfully completed similar projects. Failure to produce satisfactory references may result in the bid being deemed non-compliant.

1.8 In order to ensure project cohesion, a single point of contact is required to provide a “TURNKEY” solution. The work covered under this section of the specification consists of furnishing all; labor; cabling; equipment; supplies; materials, and training. The Contractor will perform all operations necessary for the “TURNKEY” and fully completed installation in accordance with the specifications herein. As such, the successful Contractor must be factory trained on all aspects of Network Infrastructure Cabling System.

1.9 The drawings indicate a schematic routing of cables above ceilings or in conduit below the building slab the Contractor shall field-verify the most appropriate routing of all above-ceiling cable prior to bid. Where cables penetrate through walls a conduit sleeve shall be provided. Where cables pass through fire rating of the walls, the conduit sleeve shall be sealed to maintain the rating of the wall assembly.
1.10 General Submittal Requirements

1.10.1 Phase I Submittal shall be made in electronic format within (20) working days after the award of the contract by the District. This submittal shall include the following:

1.10.1.1 Complete Bill of Materials in Excel Spreadsheet format with bills of quantities, including all materials, components, devices, and equipment required for the work. The bills of quantities shall be tabulated respective of each and every system as specified, and shall contain the following information for each Section listed:

1.10.1.2 Description and quantity of each product.

1.10.1.3 Manufacturer's Name and Model Number.

1.10.1.4 Manufacturer's Specification Sheet or Cut Sheet. Material Cut Sheets shall provide detailed product information and shall be original manufacturer product bulletins. **Copies of material information from vendor websites shall not be considered equal and will not be excepted.**

1.10.1.4.1 Material Cut Sheet part number provided shall be highlighted or provided with an arrow directed at the corresponding part number.

1.10.1.5 Specification Item Number referenced for each required product or if not shown in the specifications, Drawing Detail Number being referenced. (ie; Spec. 271000 Item 2.1 or DWG E4.15/#1)

1.10.1.6 Include with submittals all warranty information and a description of support and maintenance services to be provided. Also include all licenses and maintenance agreements required for continued operation of the equipment.

1.10.2 Phase II Submittal shall be provided within (20) working days after the approval of the Phase I submittals and prior to any fabrication or field conduit installations. All shop drawings shall be engineered in a CAD Software. Submission shall include electronic print copies to match the contract drawings, and Phase II submittals drawings shall include the following.

1.10.2.1 MDF and IDF equipment rack or cabinet elevations will be required to be provided including cable routing, grounding, support, UPS, network electronics, etc. and position of all components in the rack or cabinet.

1.10.2.2 Provide labeling plan which identifies the proposed scheme for identifying all components including Racks, patch panels (fiber and copper), site distribution feed cables, horizontal station cables and site conduit systems (handholes, pullboxes, etc.).

1.10.3 Common submittal mistakes which will result in submittals being rejected:

1.10.3.1 Not including the qualifications of the installing Contractor Company and Contractor’s Staff.

1.10.3.2 Not including all items listed in the above itemized description.

1.10.3.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items
to be reviewed (provided for the project) or crossing out the items which are not applicable.

1.10.3.4 Not including actual manufacturer’s cut sheets or catalog information of proposed products.

1.10.3.5 Do not provide website sales pages instead of Material Cut Sheets. Printing the entire web page with advertising and non-applicable items or information will not be acceptable.

1.10.3.6 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” or “to be determined later” statements. The products being submitted must be the products installed.

1.11 Component Samples and Mock-ups

1.11.1 Provide one full size installation sample mock-up of a normal wall faceplate for approval. All samples are to be fully labeled per these specifications. Samples are to be delivered to the Construction Manager’s office on site prior to installation.

1.11.2 All sample mock-ups are intended to represent the components that are to be installed as part of this project. They are to be provided with all associated components and labeling necessary to make up a complete mock-up. Installation shall not proceed until the Owner’s Representative has approved the samples. Once samples and other documents have been submitted and inspected by the Owners Representative approved, they shall be retained. Any installation that does not meet this standard shall be replaced or re-worked as approved by the Owners’ Representative at no cost to the project.

1.12 The Contractor shall make a written request directly to Johnson Consulting Engineers for electronic drawing files (CAD). As a part of the written request, please include the following information:

1.12.1 Clearly indicate Project Name and Client, Johnson Consulting Job Number (located in bottom left corner of JCE Engineering Stamp) and each drawing Sheet Number required (i.e., E1.1, E2.1, E4.1 etc.).

1.12.2 Identify the name, Company, Title, phone number, mailing address and e-mail address of the person to receive the files.

1.12.3 Detail or Riser diagram sheets, System Schematic drawings or any other drawings other than floor plans or site plans, will not be made available to the Contractor.

1.12.4 Files will only be provided in the AutoCAD format in which they were created (i.e., version 2015 or version 2016). Files will not be made available in REVIT format.

1.12.5 Requests for files will be processed as soon as possible; a minimum of 7 working days should be the normal processing time. The Contractor shall be completely responsible for requesting the files in time for their use and delays in requesting files will not alleviate the Contractor from submitting required documents within the required timeline.

1.13 Contractor shall be responsible for the complete provision and installation of all components as specified herein. The Contractor shall provide all tools, equipment, fixtures, appliances, ancillary piece parts and hardware as necessary to complete the assembly and installation as requested. The Owner’s Representative may conduct
scheduled or unscheduled inspections of the Contractor’s work at any time during construction. All work included in the scope assigned to the Contractor that is associated with this project shall be accomplished in a workmanlike manner, installed and assembled plumb, level and square. The product shall be delivered to the Owner finished complete, and ready to operate according to the manufacturer’s specifications.

1.14 All installation work shall be completed to the standard of the samples approved by the Owner’s Representative during the submittal process. Any products not installed to the quality detailed in these specifications and approved in the submittal process shall be reworked by the Installer to the satisfaction of the Owners Representative at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 Equipment racks have been detailed on the drawings and additional component information requirements have been described in the following sections and on the drawings. The following is a list of approved manufacturers for each type of rack to be furnished. Alternate equipment manufacturers other than those indicated will not be reviewed or approved for use on this project.

2.2 (Open Frame 2-Post) shall be manufactured by Chatsworth CPI Universal #46353-703 Series. Reference drawing details and specifications for complete requirements.

2.3 Open Frame 2-Post Racks, 19” mounting width by 84” High by 3” Deep with #12-24 mounting holes as shown in the IDF Room layouts. Contractor shall be responsible for providing all racks and accessories. Furnish and install with the following:

2.3.1 The racks shall be provided with structural seismic bracing using cable runway to the top of the rack.

2.3.2 Universal 18” cable runway shall be as manufactured by CPI Model 10250-718 (No Approved Equal). The cable runway shall be furnished with the additional adapters, connectors, support components, bends and offsets and extensions as required to fit the room and layout.

2.3.3 Anchor the cable runway to the wall with the appropriate width angle bracket and bolts as manufactured by CPI Model #11421-718.

2.3.4 The cable runway shall also be attached to the top of the rack with the appropriate adapter panel. Cable runway shall be directly attached to the 2-Post racks with J-Hooks.

2.3.5 Floor mounted racks shall be structurally anchored to the floor with the anchors and bolts as shown in the detail drawings.

2.3.6 Provide full length vertical wire managers, CPI Double-Sided CCS Vertical Manager with hinged doors, Part #30162-703, on each side of each rack.

2.3.7 Provide horizontal wire managers, one at the top of the rack and one at the bottom of the rack plus one at the bottom of every (2) patch panels. Provide (1) spare manager per rack. Provide 2RMU height managers CPI Part # 30530-719.

2.3.8 Provide cable runway radius drops for cable routing to the equipment racks. Provide CPI Model #14304-718.

2.3.9 Contractor shall be responsible for neatly routing, storing and connecting the power cords from the electrical outlet or UPS as directed by the District. Power cords shall be dressed separately from the UTP cables or any other low voltage
cable and shall be secured to the back of the rack or cable runway with Velcro ties.

2.3.10 Furnish grounding to each rack. Each rack shall be provided with a grounding terminal block, #6 Ground wire from the rack to the busbar and a compression lug on the end of the ground wire at the busbar. Provide grounding components as manufactured by CPI #40167-001 terminal block and #40162-901 compression lug or approved equal.

2.3.11 Provide (1) ground bus bar kit per MDF Room. Ground Bus Bar kit as manufactured by CPI #40158-012 or approved equal. Ground Bus Bar and all bonding conductors to the bus bar shall be labeled. Grounding conductors shall be routed to the equipment racks, cable runway and electrical panel.

2.3.12 All fiber optic feed cables routed to the MDF Room shall be provided with 20-feet of slack for a service loop mounted on the backboard behind the racks. Contractor shall provide a 24" diameter wall mounted service loop manager for the fiber optic feed cables as manufactured by Leviton #48900-FR. Maximum of (3) fiber feed cables per manager. Provide quantity of managers as required to manage all service loops.

MDF Room Requirements (MDF Room is Existing in Building “200”)

2.4 The Main Distribution Frame (MDF) Room shall be the central wiring and equipment location for the network infrastructure systems.

2.5 Provide Fiber Optic Feed Cable Patch Panels - Fiber optic termination equipment (rack mounted), including all associated installation hardware. The equipment must have sufficient number of ports to connect all fibers in every cable terminated at this location. Provide 25% spare capacity for future wiring requirements, including bulkheads in the fiber patch panel. Provide blank fillers for all used portions of the panel. All fiber feed cables shall be terminated in a single fiber optic patch panel up to 144 strands. Additional strands shall be terminated in the largest size required to contain the remaining fibers.

2.5.1 Contractor shall provide a minimum of 6-feet of slack on the fiber feed cable in the fiber optic patch panel. The first 48" of a tight buffered cable or the first 24" of a loose tube cable shall not be stripped back in the patch panel. Each type of cable shall have a minimum of 24" of stripped slack within the patch panel. Total slack within the patch panel shall not be less than 6-feet in length.

2.5.2 All fiber cables shall be secured to the patch panel with the Kevlar strength members at the manufacturer provided anchor point at the rear of the panel.

IDF Location Requirements (Student Services Building)

2.6 The Intermediate Distribution Frame (IDF) Room shall be a secondary wiring and equipment location for the data networking system. The Contractor shall include the following items at this location:

2.6.1 Provide backboard 8'-0" high x 3/4" thick, with a minimum 48" width. Refer to the floorplans for the actual layout of the backboard coverage. Plywood mounting backboard shall be flame resistant, painted with fire resistant paint “white” or color to match the room finish. Contractor shall provide minimum one side finish grade plywood. Backboard shall be mounted with finish side out, regardless of location of fire rating stamp. Show proof of fire rating stamp to IOR or Inspector prior to installation.

2.6.2 Fiber Optic Feed Cable Patch Panels - Fiber optic termination equipment (rack
mounted), including all associated installation hardware. The equipment must have sufficient number of ports to connect all fibers in every cable terminated at this location. Provide 25% spare capacity for future wiring requirements. Provide blank fillers for all used portions of the panel. All fiber feed cables shall be terminated in a single fiber optic patch panel.

2.6.3 Each IDF location shall be furnished with a minimum Belden Fiber Express configured for 72-Port patch panel, loaded with bulkheads to accommodate all fibers plus 25% spare. Type of bulkhead connectors shall be “LC” for Multimode and Single Mode fiber in the bulkheads, Belden FiberExpress Manager Connector Panel. Provide Belden FiberExpress Patch Panel Housing #AX105565.

2.6.4 Contractor shall provide a minimum of 6-feet of slack on the fiber feed cable in the fiber optic patch panel. The first 48” shall not be stripped back in the patch panel. Each type of cable shall be provided with Belden Field Breakout kits for the 24” of stripped slack within the patch panel. Total slack within the patch panel shall not be less than 6-feet in length.

2.6.5 All fiber cables shall be secured to the patch panel with the Kevlar strength members at the manufacturer provided anchor point at the rear of the panel.

2.6.6 Category-6 Modular Patch Panels (rack mounted) with RJ45 style connectors, for terminating all twisted pair cable from each Voice/Data/IP Speaker/Network Camera, or other devices, outlet served from this location. Provide 25% spare capacity for future wiring requirements. All patch panels shall be 48-port shall be provided at the IDF fully loaded with RJ45 outlet inserts. Confirm color requirements with District prior to ordering. Provide cable support bars at the rear of each patch panel. All cables shall be secured to bars with Velcro straps. Provide Belden GigaFlex PS6+ patch panels (No Approved Equal).

2.7 The 27 10 00 Contractor shall be responsible for furnishing and installing all Category-6 UTP data cable drops to all IP-based Mass Notification Speaker, IP based Network Camera, Wireless Access Point, Telephone and Data locations shown on the drawings.

2.8 The Category-6 UTP data cable drops to the IP-based Network Video Surveillance Cameras shall be terminated on a 1-Port surface mount outlet box, Belden #AX105352-XX. The surface box shall be stored inside the junction box at locations on walls or in hard lid ceilings and in the accessible ceiling at the location shown on the drawings. The camera locations that are to be located in the accessible ceiling shall be provided with a 20-foot service loop, sored in the ceiling. Cable slack shall be suspended in the ceiling on a J-Hook.

2.10 All fiber optic feed cables routed to the IDF locations shall be provided with 20-feet of slack for a service loop mounted on the backboard behind the racks or stored in the back of the wall mounted cabinets. Contractor shall provide a 24” diameter wall mounted service loop manager for the fiber optic feed cables as manufactured by Leviton #48900-FR. Maximum of (3) fiber feed cables per manager as required to manage all service loops. Provide a 12” diameter service loop manager in the rear of wall mount IDF cabinets by Leviton #48900-IFR.

IDF UPS Requirements

2.11 General UPS Requirements – The Contractor shall coordinate with the Division 26 Contractor to properly locate the power outlet connection for the UPS in the IDF Room. The location shown on the floor plans is diagrammatical and does not give the Division 26 Contractor an exact placement. In addition, all UPSs must be furnished with heavy duty mounting bracket kits. A UPS installed in a 2-Post IDF Equipment Rack must be furnished with a 2-Post kit that can support the full weight of the unit.
2.12 Provide (3) Heavy Duty shelves for support to the UPS and the extra batteries. Mount the shelves at the locations designated by the District IT Department. Provide shelves by CPI Model #11164-719.

2.13 Final location for the UPS, within the equipment racks for IDF locations with multiple racks, must be verified by the District IT Director or District Construction Project Manager prior to the installation of the UPS or the electrical outlet for the UPS. Coordinate with the Electrical Contractor.

2.14 At IDF Room location on the campus: Provide (1) uninterruptible power supply, 120/208-volt, single phase, rack-mounted. Provide complete with power management software, all mounting brackets and supports, all cables, environmental sensor and network interface (Ethernet RJ45-port) card. UPS shall be provided with backplane configuration containing:

2.14.1 Minimum of (12) 20-amp, 120-volt, non-locking, NEMA 5-15R/20R and (2) 20-amp, locking, NEMA L6-30R and (1) 30-amp, 120-volt locking, NEMA L6-30E output receptacles

2.14.2 Input of (1) 30-amp 208-volt, locking, NEMA L6-30P plug installed on 10'-0" power cord Network Interface card option in UPS. Software shall be included with the UPS.

2.14.3 (1) environmental sensor/monitor in the IDF Room racks. Provide and connect it to the UPS at the IDF Room. Do not connect the sensor to one of the PDUs or power strips, if applicable.

2.14.4 "APC" Smart-UPS On-Line SRT5KRMXLT-5KTF 5000VA SERIES with 2-RU Step Down 120/208-volt transformer and (2) APC Smart-UPS Model #SRT192RMBP External Rack Mount Battery Pack.

**Fiber Optic Patch Cords**

2.15 Fiber optic patch cords shall be furnished and installed by the Contractor.

2.16 All fiber optic patch cords furnished by the Contractor shall match the grade and glass of the fiber optic feed cable installed for the network infrastructure cabling system. The Contractor shall confirm with the District IT Department the type of connector required at the network equipment prior to ordering or installing the patch cords.

2.17 Multimode Fiber Optic Patch Cords - Patch cords shall be duplex 50/125um, laser-optimized, OM4 (OM4+) grade multimode optical glass. Fiber optic patch cords shall be furnished with LC (SC) connectors at the network switch port end and LC (SC) connectors at the fiber optic patch panel end. Fiber patch cords shall be furnished with ceramic ferrules. All Multimode patch cords shall be Aqua (Lt. Blue) in color. Patch cords shall be 6-feet (2-meters) 3-feet (1 meter) in length. Provide adequate patch cords to patch all strands of the fiber cables.

2.18 Single Mode Fiber Optic Patch Cords - Patch cords shall be duplex 8.3/125um, (OS2) grade single mode optical glass. Fiber optic patch cords shall be furnished with LC (SC) connectors at the network switch port end and LC (SC) connectors at the fiber optic patch panel end. All Single Mode patch cords shall be Yellow in color. Patch cords shall be 6-feet (2-meters) 3-feet (1 meter) in length. Provide adequate patch cords to patch all strands of the fiber cables.

2.19 Contractor shall be responsible for confirming the network switch connections with the District IT Director prior to ordering or installing the patch cords.
Copper Patch Cords

2.20 Copper patch cords shall be furnished and installed by the Contractor

2.21 Provide Category-6 (Patch Panel End) patch cords with pre-molded boot, provide quantity equal to:

2.21.1 Provide 100% of the total Category-6 cable ports provided on the patch panels

2.21.2 All patch cords to be installed by Contractor. Provide 100% of total copper patch cords required to be (10) feet in length

2.22 Provide Category-6 (Workstation End) patch cords with pre-molded boot, provide quantity equal to:

2.22.1 Provide 100% of the total Category-6 cable ports provided on the patch panels

2.22.2 All patch cords to be installed by Contractor. Provide 100% of total copper patch cords required to be (10) feet in length, unless otherwise noted

2.22.3 Patch cords installed at WAP (Wireless Access Point) locations IP Camera and IP Intercom locations shall be (2) feet in length

2.23 Requirements for all copper patch cords furnished:

2.23.1 Color of patch cords shall be determined by the color code shown in the detail drawings

2.23.2 Patch cords shall be as manufactured by Leviton, Commscope, Panduit, Ortronics or Siemon based on the network infrastructure system furnished by the Contractor

2.23.3 Patch cords furnished must be in compliance with the manufacturer’s “Channel” warranty requirements. Patch cords not warranted through the selected manufacturer Channel warranty program will not be approved for use with the network infrastructure

2.23.4 Provide all other items as detailed on the drawings.

Campus Indoor/Outdoor Fiber Optic Feed Cable

2.24 Provide one continuous fiber optic cable routed from the Main Distribution Frame fiber patch panel to each Intermediate Distribution Frame fiber patch panel, and/or other locations as shown on the drawings

2.25 All fiber shall be installed in a Sumitomo air blown fiber tube system installed in 1-1/4” outdoor rated innerduct. The innerduct shall be provided in the site conduit from the MDF Room to the IDF Room location. Provide a 4-Cell air-blown outdoor all-dielectric, water-blocked, wit CSM fiber optic tube in the innerduct. The air-blown tube shall be routed directly to the fiber optic patch panel at both ends of the run. Provide Sumitomo 4-Cell air-blown outdoor all-dielectric fiber optic tube Part #TC04TOD (No Approved Equal)

2.26 Fiber optic feed cables for the data infrastructure must be installed as follows:

2.26.1 Air-blown Fiber Optic feed distribution – Fiber optic air-blown tube system containing both Multimode and Single Mode strands. Multimode and Single Mode air-blown strands shall be installed in separate tubes in the air-blown tube cable. Provide a total of 12-strands of air-blown OM4 Multimode and 12-strands
of air-blown Single Mode, as shown on the riser diagram to the IDF location.

2.26.2 Fiber optic tube cables shall be clearly defined and labeled for each system. Provide color coding designations with a different color marker for the multimode and/or single mode fiber feed terminations in the fiber patch panels.

2.27 Cable shall contain one or all types of fibers listed below:

2.27.1 Provide Multimode 50/125-micron fiber optic glass, (minimum OM4+ laser-optimized grade, extended distance) for dual mode operation at 850 nm and 1300 nm wave lengths. The fiber optic glass shall conform to the following:

2.27.1.1 50/125-micron multimode optical fiber cable with glass core and cladding (tolerance 50 +/- 3 micron, 125 +/- 2 micron)

2.27.1.2 Graded refractive index profile

2.27.1.3 Attenuation coefficient at 850 nm of 3.5 dB/km or less

2.27.1.4 Attenuation coefficient at 1300 nm of 1.5 dB/km or less

2.27.1.5 Bandwidth distance product at 850 nm of 4900 MHz.km or more (laser) and 1500 MHz.km (overfilled launch)

2.27.1.6 Bandwidth distance product at 1300 nm or 500 MHz.km or more

2.27.1.7 Individual glass elements proof tested at 100 kpsi (100,000 lbs. per square inch)

2.27.2 Single mode 8.3/125-micron fiber optic glass, (minimum OS2) High Performance grade for dual mode operation at 1310 nm and 1550 nm wave lengths. The fiber optic glass shall conform to the following:

2.27.2.1 8.3-micron core diameter, 125-micron cladding diameter (+/- 1 micron)

2.27.2.2 Mode filed diameter of between 8.7 and 9.3 (width +/- 0.5-micron tolerance at 1310 nm)

2.27.2.3 Attenuation coefficient at 1310 nm of 1.0 db/km or less

2.27.2.4 Attenuation coefficient at 1550 nm of 1.0db/km or less

2.27.2.5 Cladding non-circularity of +/- 1%

2.27.2.6 Core to cladding concentricity error of no more than 0.8 micron

2.27.2.7 Maximum dispersion rate of 3/80 ps/nm-km at 1300

2.27.2.8 Maximum dispersion rate of 17,00 ps/nm-km at 1550 nm

2.27.2.9 Individual glass elements proof tested at 100 kpsi (100,000 lbs. per square inch)

2.28 All fibers shall be fully terminated and tested, unless otherwise noted in the drawings or in these specifications.

2.29 Refer to drawings for cable types required. Refer to acceptable cable sections for additional information and approved manufacturers.
2.30 All fiber optic strand bundles shall be installed using the Sumitomo Air-Blown blowing equipment using compressed air or nitrogen at up to 150 feet per minute. Fiber strand bundles may not be installed using a standard vacuum cleaner or shop vacuum. The blowing equipment must be manufactured for and certified for the installation of the air-blown fiber bundles.

2.31 All fiber strands shall be fusion spliced at the fiber optic patch panel location in the MDF/IDF Room. Provide fusion splice trays in the fiber optic patch panel for protection and management of all fusion splices. Fusion splice rays shall be Belden FiberExpress compatible and shall be installed in the fiber optic patch panel.

2.32 Each fiber optic cable shall contain the quantity of strands of optical fibers as detailed on the drawings.

2.33 All fibers in a multi-fiber cable shall be fully operational within the required performance characteristics. If any individual fiber does not meet the minimum standards, the entire cable must be replaced, end to end, including connectors, without any additional expense to the customer.

2.34 Acceptable fiber optic strand distribution shall be:

2.34.2 Sumitomo Multimode Bundle – 10Gb 550 Meter OM4 Multimode 12-fiber #FB12G55

2.34.3 Sumitomo Single Mode Bundle – OS2 Single Mode 12-fiber, #FB12SXS

2.34.4 All the above types are an example of product names per Sumitomo FutreFlex product information. Confirm requirements for fiber strand bundles with riser drawings and site plans. Contractor shall confirm part numbers with manufacturer. (No Approved Equal)

**Category-6 Station Cable**

2.35 Contractor shall provide a Category-6 UTP cable to each Data, Voice, Wireless Access Point, IP Page, Audio-Visual Data Connection, IP Camera or any other locations as indicated on the drawings and specifications. Provide quantity of cables as indicated on the drawings at each location.

2.36 Provide one Category-6, 4-pair, unshielded twisted pair (UTP) cable from the nearest MDF or IDF location to each RJ45 data outlet port indicated on the drawings. Dual port outlets will require two such cables. Four port outlets will require four cables. Refer to the drawing details for jacket color requirements for each type of connection. Color of cable jacket for each type of connection shall be determined by the drawing details. Confirm color of cable jackets prior to ordering with the District IT Director. Contractor shall be responsible for providing the correct jacket color per the drawings per District Standards.

2.37 Unless otherwise shown in drawing details, the color of the Category 6 UTP cables shall be blue, shall be copper wire, individually insulated and color coded.

2.38 The cables shall be UL or ETL rated and UL verified in compliance Category-6 EIA/TIA standards. Approved cables for Network Infrastructure System:

- Belden — Gigaflex 2600 Series, Riser Rated Category — Cable #3612, black jacket

2.39 Where data cables are indicated to run underground, Contractor shall use a Category-6 OSP-rated cable. Approved cables for Network Infrastructure System:

- Belden — OSP6U
2.40 Manufacturer names and part numbers are shown as a point of reference and do not specifically designate required packaging or color for the cable. Contractor shall verify colors and packaging options shall be determined by Contractor preferences.

**IDF to MDF Voice Feed Cables**

2.41 Provide 25-pair OSP telephone feed cable from each IDF to the MDF, unless otherwise shown on the drawings.

2.42 External Gel-Filled ASP Cable, Provide Belden, no equal (Sole Source), filled core telephone cable suitable for direct-burial or in-duct applications. The cable shall have solid annealed copper conductors, with a core filled with a Flex-Gel filling compound and wrapped in a non-hygroscopic core tape. The ASP sheath shall consist of a 0.008" corrugated aluminum shield, with a 0.006" corrugated steel shield and a black polyethylene jacket. The jacket shall be sequentially printed with a footage marker at regular intervals. A flooding compound shall be applied over the core and to all surfaces of the aluminum and steel shields to resist moisture entry and to inhibit corrosion. Provide printed length markings on the cable jacket every two feet.

2.43 For voice feed cables, terminate all pairs on both ends of the cable on the MDF/IDF Room equipment racks on Belden Bix-Type termination blocks. building entrance protectors on the termination blocks. The termination blocks shall be mounted on a rack mounted frame adapter. Follow standard voice color codes for termination. Coordinate the location of the termination blocks with the District IT Department.

2.44 All voice feed cables will be tagged on the incoming cable with a typed permanent label with information as to its origin, house pair count, and cable destination. All termination blocks shall be labeled with type written labels that fit between the termination blocks (e.g, clear Snap-On covers, adhesive labels and holders). Pairs shall be identified a minimum of every 5 pair on the black.

2.45 Provide distribution rings for the termination blocks mounted on the equipment rack. Contractor shall be responsible for any analog vice truck cross-connects in the MDF/IDF Rooms. Confirm trunk requirements with the District IT Department and the final destination of the trunks (ie: Security Panel, Fire Alarm Panel, etc).

2.46 Ground and bond feed cables at one end of cable to aluminum shield with approved “bullet bond” type ground lug and #10 AWG green ground wire. Connect ground wire to closet ground buss bar.

2.47 Acceptable manufacturers shall be: Belden (No Approved Equal), for OSP cable applications.

2.48 Data Contractor is responsible for providing the District with detailed feed cable documentation as well as identifying all the physical cable in the MDF and IDF locations. Contractor shall have all installation, termination and documentation of voice feed cable completed, and released to the telephone equipment vendor, a minimum of three weeks prior to the cut-over date set by the District.

**Category-6 Outlets**

2.49 Unshielded twisted pair Category-6 outlets shall be an RJ45 Enhanced performance type 8-position / 8-conductor modular jacks and shall comply with Category-6 performance requirements. Provide single port, dual port, four port or quantity as indicated on the floor plans at each outlet location.

2.50 Provide Category-6 inserts with pin-outs conforming to the T568B standard. Provide installation kits for all locations furnished with Category-6 UTP cabling.
2.51 All work area Category-6 outlets shall be furnished blue in color, unless otherwise directed by the District. Contractor shall be responsible for confirming all color requirements prior to ordering.

2.52 Provide the following Category-6 UTP data connector per Network Infrastructure warranty requirements:

2.52.2 Belden GigaFlex Cat6+ Series Part #AX104192 (Blue)

**Outlet Faceplates**

2.53 Provide a four-port faceplate for all data outlet locations, unless otherwise noted on the drawings or in these specifications. Provide blanks for all unused openings.

2.54 Locations requiring a quantity beyond four ports will be shown on the project drawings. Provide the appropriate size faceplate and quantity of inserts as required.

2.55 All fax/modem locations shall be provided as single port outlets. Requirements shall be the same as a single port data outlet as shown on the Technology Legend.

2.56 For single port voice outlet locations intended for wall telephone connections, a wall telephone type faceplate that will allow the telephone to be mounted over the faceplate shall be provided. The wall telephone jack shall be Category-6 insert 8-pin, RJ45 type only. Provide faceplate from Belden as listed in the specifications.

2.57 Provide single port small surface mounted outlet box for IP Speaker Mass Notification data outlets located in the surface mount back can or in the location junction box. Provide 1-Port surface mount box by Belden #AX105352-xx. Provide Category-6 series insert, in 1-Port surface box for IP Speaker Mass Notification data locations mounted in the speaker back can as shown in the detail drawings.

2.58 Provide single port small surface mounted outlet box for IP Network Camera data outlets in the J-Box for the camera location or in the accessible ceiling at the location shown on the floor plans. Provide 2-Port surface mount box by Belden #AX105353-xx. Provide Category-6 series insert, in 2-Port surface box for IP Network Camera data locations. Exterior wall locations shall also be furnished with a blank weather-tight faceplate to protect the data termination until the cameras are installed.

2.59 Confirm color of all faceplates prior to ordering. All data outlet faceplates shall have a unique type-written label with the identification numbers and letters applied to the faceplate. Hand written labels are not permitted. All color schemes shall be approved by the customer prior to installation.

2.60 Colored data outlets are required for this project. Refer to the detail drawings for the exact color scheme to be provided. Inserts submitted that do not follow the color and identification requirements will be rejected. Inserts installed that do not follow the color coding as shown in the detail drawings will be replaced at the Contractor’s expense. Confirm all color options with the District IT Department prior to ordering or installing.

2.61 All faceplates and surface mount outlet boxes shall be furnished with label windows. All labels will be installed under label windows. Labels adhered to the surface of the faceplate will not be accepted, with the exception of the surface outlet boxes for the IP-Based Speakers and Camera locations. Contractor must provide clear nail polish or a clear laminating type of cover material over the surface mounted labels where used.

**PART 3 – IP MASS NOTIFICATION SPEAKER REQUIREMENTS**
3.1 The Contractor shall furnish and install the IP-based speakers and horns for mass notification and all associated hardware and software.

3.2 Data Contractor shall be responsible for providing enclosures for all IP-based speakers and horns. Contractor shall provide vandal resistant screws with all enclosures for attachment of the speaker/horn baffle. Exterior locations shall be provided with stainless steel vandal resistant screws.

3.3 Enclosures in walls shall be furnished and installed by the 27 10 00 Contractor and installed by the 26 00 00 Contractor.

3.4 Mass Notification speakers and horns shall be manufactured by Atlas. The speakers and enclosures will be procured by the 27 10 00 Contractor

3.5 Provide speakers and enclosures for the IP-Based Speakers and Paging Horns for the following types of locations as shown on the drawings:

3.5.1 Flush wall mount IP Speaker Only, Atlas Sound Part #18S+ - provide flush mount straight enclosure Part #FEST-18S

3.5.2 The same enclosure shall be provided for any IP-Based speaker only being placed in a non-accessible (Hard Lid) ceiling space. The enclosure shall be secured to the structure above with a minimum of (4) ceiling support type 12-AWG wires or framed in placed and attached to the structural members. Contractor shall field modify the enclosure to allow for connection of the support wires.

3.5.3 Accessible ceiling mount IP Speaker Only, Atlas Sound Part #I128SYS+. Speaker is a 1-foot by 2-foot drop-in type for accessible ceilings. Speaker shall include T-bar attachment for cut-in location

3.5.4 Flush mount IP Standard Page Horn Atlas Sound Part #IHVP+ - provide flush mount enclosure Part #FEST-IH stainless steel construction, no finish

3.5.5 Provide a 2-foot long, CAT-6, UTP patch cord, for the speaker/horn location to connect to the data drop located in the enclosure. Color of patch cord per District IT Department instructions. Provide patch cords for 100% of IP-based speaker/horn locations.

3.5.6 IP speakers/horns shall be connected to a POE switch in the MDF / IDF Room or cabinet. Coordinate the connection of the POE powered devices with the District IT Department. Speakers/horns must be patched to a POE powered switch in the MDF/IDF to allow for proper operation

3.5.7 All speaker/horn connections to be terminated at the data patch panel and identified with a colored insert or color tabbed label, per the District Standards or as shown in the detail drawings and instructions.

**IP-Based Mass Notification Software**

3.6 District already owns the main server and control software for the IP-Based speaker system. Existing Software is as manufactured by Atlas/SingleWire “Informacost” platform. Provide latest version of software available at the tome of installation. The speakers shall be controlled remotely from the Main Campus of Mira Costa College.

3.7 Contractor is responsible for providing all licensing requirements for the new speakers and horns. Provide software updates (as required to bring project up to date) to drive the new speakers/horns, program tomes, load any WAV files required and announcement
3.8 Programming of new speakers and horns for page coverage zones, tones, and time schedules. Emergency Notifications and VoIP interface to be completed by the Contractor. The District will be responsible for providing IP addressing to the Contractor for the network to identify individual zone controllers.

3.9 Programming of speakers for page coverage zones, tones, time schedules, pass class bell and VoIP interface to be completed by 27 10 00 Contractor and is also responsible for providing IP addressing and identification of individual speakers and horns.

3.10 Contractor to provide a minimum of 4-hours of meeting time with the District IT Director to confirm all programming requirements. The Contractor shall provide Meeting Minutes to the District and the Project Engineer of record for approval. Contractor shall not program system until programming proposals have been approved.

PART 4 – IP BASED NETWORK VIDEO SECURITY CAMERA

4.1 Provide (2) Category-6 UTP cables from the IDF closet to each camera location shown on the drawings within the allowable Category-6 distance limitation (290 feet or less). Cable runs to exterior camera locations within the allowable distance limitation on light poles shall be provided with OSP-rated Category-6 cable. Locations beyond the 290-foot distance limitation shall be provided with a fiber optic cable for the camera connections.

4.2 The cables shall be terminated at the camera location on a surface mount “biscuit” type jack. The jack shall be installed inside the conduit box at the camera location or in the accessible ceiling if there is no junction box associated with the camera location.

4.3 Contractor shall confirm the distance to the camera locations prior to the ordering or installation of the fiber optic station cabling. Provide the distance for each cable run to the Project Engineer prior to the installation of any cabling.

4.4 Locations beyond the 290-foot distance limitation shall be provided with a 4-Strand, 50/125um, “OM4” Multimode, OSP, tight buffer fiber optic cable. The cable shall be Indoor/Outdoor Riser-Rated 4-Strand Belden #FD4D004R9.

4.5 The cable shall be terminated at both ends with “LC” type connectors. All fibers shall be terminated.

4.6 Provide a separate fiber optic patch panel in the IDF Room equipment rack for the fiber optic station cable runs to the cameras. Route the fiber to the fiber optic patch panel in the equipment rack and provide “LC” OM4 Multimode connector panels to accommodate all strands. Provide a minimum of 25% spare capacity for the fiber optic patch panel for future use.

4.7 Terminate the cable at the exterior camera pole location and provide a small surface mount fiber panel in the base of the pole. Provide Corning “WMO” fiber enclosure with duplex “LC” OM4 Multimode connector panels in the WMO. Provide a 10-foot service loop in the junction box in the base of the light pole.

4.8 Refer to the drawings for the locations requiring a fiber optic cable drop.

4.9 Cable locations shall be provided for future Network Cameras, unless otherwise noted on the drawings.

PART 5 – WIRELESS ACCESS POINTS (WAP)

5.1 Category-6 UTP cables shall be provided from the IDF closet to each WAP location shown on the drawings. The cables shall be terminated as shown in the specifications.
5.2 The District will furnish all WAP devices to the Contractor for installation. The Contractor shall install each WAP as shown in the drawing details and install patch cord. The Contractor shall provide a list including the room number, location, and MAC address of each device installed to the District IT Department.

5.3 Designers shall verify proper WAP locations in all spaces, locate each so that they provide maximum coverage in each space, and triangulate each location with adjacent spaces to maximize coverage. Provide minimum 25’ slack cable at each WAP location.

PART 6 – EMERGENCY PEDESTALS

6.1 Provide (4) Category-6 UTP cables from the IDF closet to Emergency Pedestal location shown on the drawings within the allowable Category-6 distance limitation (290 feet or less). Cable runs to Emergency Pedestal locations within the allowable distance limitation shall be provided with OSP-rated Category-6 cable. Locations beyond the 290-foot distance limitation shall be provided with a fiber optic cable for the Emergency Pedestal connections. The cables shall be terminated in the base of the pedestal on a 4-port faceplate on a surface mount box. Connections to the Emergency Pedestal and all devices in the pedestal shall be provided by the 28 23 05 Contractor. Coordinate to the location of the outlet with the 28 23 05 Contractor.

4.10 Contractor shall confirm the distance to the Emergency Pedestal locations prior to the ordering or installation of the fiber optic station cabling. Provide the distance for each cable run to the Project Engineer prior to the installation of any cabling.

6.2 Locations beyond the 290-foot distance limitation shall be provided with a 4-Strand, 50/125um, “OM4” Multimode, OSP, tight buffer fiber optic cable. The cable shall be Indoor/Outdoor Riser-Rated 4-Strand Belden #FD4D004R9.

6.3 The cable shall be terminated at both ends with “LC” type connectors. All fibers shall be terminated.

6.4 Provide a separate fiber optic patch panel in the IDF Room equipment rack for the fiber optic station cable runs to the Emergency Pedestals. Route the fiber to the fiber optic patch panel in the equipment rack and provide “LC” OM4 Multimode connector panels to accommodate all strands. Provide a minimum of 25% spare capacity for the fiber optic patch panel for future use.

6.5 Terminate the cable at the Emergency Pedestal location and provide a small surface mount fiber panel in the base of the Emergency Pedestal. Provide Corning “WMO” fiber enclosure with duplex “LC” om4 Multimode connector panels in the WMO. Provide a 10-foot service loop in the base of the Emergency Pedestal.

6.6 Refer to the drawings for the locations requiring a fiber optic cable drop.

PART 7 - INSTALLATION CATV COAXIAL CABLE REQUIREMENTS

7.1 Provide a OSP-Rated RG-11 Coaxial feed cable from the existing MDF Room in the adjacent building to the new IDF Room in the new Student Services Building. The cable shall be terminated in the existing MDF Room at the existing CATV Head-End Cabinet. Provide splitter in the Head-End Cabinet to extend the incoming Cox Digital CATV service to the IDF Room. The coaxial shall be connected to the amplified output of the existing Coaxial Amplifier in the Head-End Cabinet. Terminate the feed cable in the IDF Room on the Communications Backboard and provide the cable with a splitter to connect to the RG-6 Coaxial station cabling to the flat panel monitors.

7.2 Type RG-11 CommScope Part No: F11SSE APD SM MT Quad Shield Coaxial cable with flooding compound shall be used for trunk feed in an outdoor installation. Minimum
14AWG solid copper center conductor with .28” OD dielectric over center conductor. Minimum Attenuation per 100-feet for this cable shall not exceed .96 dB at 55 MHz and 6.00 dB at 1800 MHz. Overall cable outside diameter .407 inches.

7.3 Provide a Quad Shield RG-6 Coaxial cable to each flat panel location as designated on the drawings. The cable shall be terminated at the flat panel location in the data faceplate on a female feed thru coaxial insert provided by the 271000 Contractor. Terminate the other end on the Communications Backboard at the entrance location of the feed cable from the MDF Room. Connect the cables to the splitter to extend the Digital CATV service to the flat panels.

7.4 Type RG-6 CommScope Part No: F6SSVV SM MT Quad Shield Riser-Rated coaxial cable shall be used for indoor station runs. Minimum attenuation per 100 feet for this cable shall not exceed 1.60 dB at 55 MHz, and 8.97 dB at 1800 MHz. Provide a dedicated cable from each designated location to the IDF closet location backboard or cabinet as shown on the drawings.

7.5 Terminating Resistors: Terminating resistors with 75-ohm impedance shall be installed at unused ports and feeder line ends. Terminating resistors shall be designed to cover the frequency range from 5 MHz to 1800 MHz with minimum return loss.

7.6 Directional Coupler Taps, Flush-Mounted, one-port and multi-port (multi-ports up to 4 taps) directional couplers shall be provided as required for signal distribution. The directional couplers shall be:

7.6.1 Fully shielded and in compliance with FCC rules pertaining to radiation.

7.6.2 Capable of frequency range of 50-1800 MHz.

7.6.3 Available in nominal tap loss values of 8, 11, 14, etc. The tap loss values shall be available in increments of 3 dB and the return loss at any terminal shall be 16 dB or higher.

7.6.4 Provide with compression style "F" connectors. Twist-on or crimp-on type connectors will not be accepted or considered equal.

7.6.5 The tap shall be housed in a rugged cast aluminum case and shall be capable of mounting in a standard electrical wall outlet box.

7.6.6 Directional couplers used within the building for classroom distribution shall be provided with "F" connectors.

7.6.7 Broadband Mixing/Splitting Devices shall be used in the system as required. These units shall be housed in a rugged cast aluminum housing equipped with flanges to permit mounting on any flat surface and must meet FCC specifications on radiation.

7.7 271000 Contractor will be responsible for fully testing the digital broadband system to 1800MHz prior to final connection to the A/V equipment by the 27 20 00 Contractor. All cables and distribution will be tested up to each drop location from the MDF Room.

PART 8 - INSTALLATION

8.1 Upon completion of 10% of the cabling installation, the Contractor shall notify the Project Engineer for an inspection of the methods and types of materials used on the project. The Contractor shall give a minimum of 72 hours notification to the Project Engineer for the scheduling of the inspection. The Contractor will be given a written review of the finds, so if adjustments are required, they can be done before the project proceeds.
Contractor shall be responsible for adhering to the finds and a follow-up inspection will not be provided.

8.2 Pull strings shall be provided with all cable runs including but not limited to; conduit stub ups, conduit sleeves, cable trays, open wiring routes, innerduct, and point-to-point conduits. Pull strings shall be free from cable bundles in open wiring routes. Pull strings shall not be substituted for pull ropes for the exterior site conduits.

8.3 Velcro cable management straps are required on all Category-6 cable bundles, the last 20 feet or upon entry into equipment closet, a maximum of 12” apart. Cable bundles shall also be routed through cable management or “D” rings in the equipment closet.

8.4 Data Contractor shall supply protective bushings or slide on rings at the ends of all exposed conduits used for the data system cabling. This is to include all conduits installed for any future data cabling requirements. Contractor shall submit planned protection bushings prior to installation of cabling for approval.

8.5 Velcro cable management straps are required on the cabling in the rear section of the vertical managers on the equipment racks. Straps shall be a maximum of 12” apart. At a minimum, Velcro straps shall be provided at each point the cables are routed to the patch panels from the main bundle.

8.6 Every fiber in every fiber optic cable must be terminated at both ends on a fiber patch panel in the MDF/IDF closet or cabinet location. Termination shall be accomplished using the correct style of connectors as directed by the District with a strain relief boot. All connectors shall be of the same manufacture to ensure compatibility. Polarity of fiber strands must be observed at all times.

8.7 Labeling

8.7.1 Each cable run shall be permanently labeled at each end with a unique sequential number which corresponds to a similar number provided for each data outlet and patch panel point. A printed label shall be placed at each of the following locations:

8.7.1.1 On the cable at the rear of the patch panel or termination block. Requires the use of a self-laminating wrap around label. Brady Label self-laminating 1.2" by 1.5" wrap around label Part #29689 (NO ACCEPTABLE EQUAL).

8.7.1.2 On each cable in the j-box behind the faceplate location. Requires the use of a self-laminating wrap around label. Brady Label self-laminating 1.2" by 1.5" wrap around label Part #29689 (NO ACCEPTABLE EQUAL).

8.7.1.3 On the cable at the terminal strip prior to termination point. Requires the use of a self-laminating wrap around label. Brady Label self-laminating 1.2" by 1.5" wrap around label Part #29689 (NO ACCEPTABLE EQUAL).

8.7.1.4 On the face of the patch panel, provide a 3/4" by 3/4" label with a letter or number identifying the patch panel designation. For special purpose data connections such as WAP, Audio-Visual, IP Page and IP Camera ports, the label shall be designated with colored label icon or marker.

8.7.1.5 On the face of the faceplate in the label holder window. The label shall be clearly defined with a minimum #10 font size.
8.7.2 Hand written labels are not permitted. Where cable ID includes room number identification, the Contractor shall obtain written verification of final room numbers prior to beginning labeling (numbers on plans do not always match final room numbers). Cable pulling cross reference lists will not be accepted with final documentation.

8.7.3 Each patch panel port shall be identified with a unique sequential labeling scheme. Port identification labeling pattern shall be consistent throughout the project.

8.7.4 All faceplates shall be identified with permanent printed labels. Labels must not be subject to removal by incidental contact. Contractor shall be responsible for replacing defective labeling for a period of one year from date of final sign-off of project.

8.7.5 All fiber optic and UTP feed cables shall be identified with a permanent, water resistant, printed labels. Labeling information shall include closet identifications, quantity of conductors (UTP) or strands (fiber) and house pair designations (UTP). Cables shall be labeled in the IDF/MDF closets at the site conduit entrance point, Riser conduit entrance point and prior to entering either punch blocks or patch panels. Labels for fiber and copper feeds shall include both the name of the origination point and the destination point, house pair or house fiber strand count, cable composition (ie: 12-Strand MM 50/125 LO; 6-Strand SM). See details for additional requirements.

8.7.6 Labeling will follow recommended EIA/TIA standards or as requested by the customer. Contractor will confirm labeling pattern prior to final identification or testing. All test results will be identified by the final labeling scheme. Contractor shall be required to have the labeling scheme approved in writing by the District IT Director prior to manufacture or installation of the labeling.

8.7.7 All fiber optic cables and/or innerduct shall be tagged with fiber optic warning tags in every manhole or pullbox. Fiber warning tags shall also be placed at each end of the cable in the termination closets in clear view. A minimum of (3) tags are required at each end, with a label tag on each cable in the service loop. Fiber warning tags shall be placed on fiber optic cable and/or innerduct routed through open ceiling environments at increments no less than 15 feet apart.

8.7.8 Refer to detail drawings for additional labeling requirements.

8.8 Where open wiring cables are run through the ceiling space (only permitted where specifically noted on the drawings), the wire shall be bundled together and supported above the ceiling.

8.9 All cables must be fastened to the building structure via “j-hooks” or an approved Category 6 suspension system, and not directly in contact with ceiling system. For “j-hooks” maximum fill capacity is as follows: 1-5/16” hooks – 35 cables; 2” hooks - 60 cables; 4” hooks - 120 cables. For quantities beyond 120 cables use a sling support system such as “Erico Cable Cat” or equal. Maximum fill capacity 200 cables. D-rings, “Caddy #WAX cable hangar”, “Caddy Bridle Rings”, drive rings or any other type of wire ring support is not allowed.

8.10 Where cables pass through a fire-resistant portion of the structure, conduit sleeves shall be provided to maintain the rating of the wall penetrated. Sealing of all penetrations with an approved fire barrier is required. Conduits and sleeves must remain accessible for future use. Permanent sealants may not be used to seal sleeves and conduits.

8.11 The 27 10 00 Contractor shall be responsible for fire-stopping all unused conduit sleeves in the ceiling or through rated walls. The Electrical Contractor shall be responsible for fire-
stopping around the conduit or sleeve, unless the sleeve is installed by the 27 10 00 Contractor, in which case, the 27 10 00 Contractor shall be responsible for all fire-stopping requirements.

8.12 Expanding foam is not an acceptable sealant for any conduit opening. Contractor shall be responsible for complete replacement of the conduit and cabling in any conduit filled with expanding foam used as a sealant.

8.13 Fiber optic feed cables connecting to equipment racks from the MDF Room or from an adjacent IDF location, shall be installed with not less than a 20-foot service loop between the rack and mounted on the backboard. See drawings for fiber optic service loop requirements.

8.14 Provide 6 inches of cable slack at computer data system outlets inside conduit box.

8.15 In an accessible ceiling area, provide a 10-foot (stored in a Figure-8 configuration) service loop above the all data/voice outlet locations. Service loop must be securely tied up off of ceiling tiles or ceiling surface and supported at two opposite points. Neatly coil cable without exceeding minimum bend radius limitations. Do not provide length in excess of 15 feet, as it may cause improper test results and errors.

8.16 Do not provide a service loop in the MDF/IDF Room on the UTP cables, unless otherwise noted. Cables shall be neatly routed around the perimeter of the room to the cable runway from the point of entrance into the room.

8.17 The minimum bending radius for all cables and the maximum pulling tension shall not exceed manufacturer’s recommendations.

8.18 Cables installed in manholes and pullboxes shall be supported with Velcro ties or loosely fitted UV rated tie wraps, on wall mounted cable support racks. The cables shall be clearly labeled in the manhole or pullbox.

8.19 Provide a full 360-degree loop of slack cable around manhole and pullbox interiors. Cables entering handholes from the bottom, shall not be allowed to touch the bottom of the cover when closed and shall not be pinched or crushed in anyway.

8.20 Cable pulling shall use a split mesh grip over the cable jacket. Connection directly to optical fibers and copper wire conductors shall not occur.

8.21 When pulled through conduits, cable pulling lubricants shall be continuously applied to all cables and be specifically approved by the manufacturer.

8.22 Where cables are pulled through or pulled from a center of run, pull without splices or terminations, lead out the cables at all manholes, pullboxes, and conduits, taking care to feed them in again by hand for the next run.

8.23 For each cable pull where a cable direction change is required, flexible feed-in tubes, pullout devices, multi-segmented sheaves, etc., shall be used to ensure proper cable pulling tensions and side wall pressures. Cables shall not be pulled directly around a short right-angle bend. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to ensure the minimum possible cable sidewall pulling pressure. Do not use devices with multi-segment “roller” type sheaves. Cable lengths over 250 feet shall be machine pulled, not hand pulled. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than 50 feet per minute. Minimum pulling speed shall be greater than 15 feet per minute.
8.24 A pull string shall be placed with all UTP and paging station cables at the time of installation. Conduit runs and surface raceway for station cabling shall be furnished with a minimum 2-Ply spiral wrap style, pull string rated for 240 ft/lbs. pulling strength, such as manufactured by Greenlee #431 or approved equal. Includes all conduit stubs and cables routed through open ceilings and cable trays. Pull strings shall be tied off in the junction box and in the ceiling. Provision for the installation of the pull string shall apply to all empty and spare conduits as well. Single ply type pull string will not be accepted as a substitute for the 2-ply pull string.

8.25 A measuring pull tape shall be placed with all feed cables at the time of installation. Indoor riser and Outdoor conduit runs between buildings designated for feed cabling, in excess of 150 feet shall be provided with a minimum ½” polyaramid style, measuring true tape pull string annotated with footage increments rated for 2500 ft/lbs. pulling strength, such as manufactured by Greenlee #39245 or approved equal. Conduit runs less than 150 feet shall be furnished with a ¼” polyaramid style, measuring true tape pull string annotated with footage increments rated for 1250 ft/lbs. pulling strength, such as manufactured by Greenlee #39243 or approved equal. Provision for the installation of the measuring pull tape shall apply to all empty and spare conduits as well. Standard twine style pull strings and standard nylon or polypropylene style pull ropes will not be accepted as a substitute for the polyaramid measuring tape type pull string.

8.26 When pulling cable through conduit, cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to the reel.) Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pullbox during this operation. Cables shall be pulled directly from cablereels.

8.27 All cables shall be new and extend continuous from each MDF or IDF backboard or rack to all outlet locations.

8.28 Where cables are not installed in a conduit or other raceway system, they shall not be routed parallel with other line voltage equipment or wiring (120 volt and above) within 36” or within 12” of line voltage equipment or wiring where crossing.

8.29 Where OSP-Rated UTP cables or OSP-Rated fiber optic cables are routed exposed through ceilings for more than 50'-0", Contractor shall install the cable in innerduct or EMT conduit in the ceiling. Innerduct installed in the accessible ceiling space shall be a minimum of riser rated and a minimum of 1” in diameter. Innerduct shall be supported a minimum of every 3-feet to the structural members.

TESTING

8.30 All Category-6 cables shall be point to point (link) tested after installation/termination and verified to operate at minimum 1000Mbps. Performance of installed cables shall satisfy all current addendums to the EIA/TIA 568A standard for Category-6 wiring. In addition, testing shall satisfy all proposed amendments to the existing ISO/IEC requirements. The wiring shall support all specified communication protocols. Testing shall support the Category-6 requirements by the EIA/TIA.

8.31 Upon completion of testing cable links for both copper and fiber optic cabling, the Contractor shall supply a copy of the original database files downloaded from the tester in original format on a USB Flash Drive. Contractor shall provide with the testing database files, an original copy of the tester’s manufacturer software program (included in original cost) for record management and archiving, in a Windows format (i.e.; Fluke Linkware software program)

8.31.1 The manufacturer’s software program will be used by the Project Engineer to
review all test results, and then turned over to the District to keep as their record copy with the final approved test results. Provide (3) copies of tests on USB Flash drive. Do not submit test results for review in Excel or PDF file formats, as the submittal will be rejected and not reviewed.

8.32 Contractor will repair or replace cable runs or connecting hardware that do not meet specified criteria.

8.33 Upon completion of submittal of original test results, and after review and approval of those results, the Contractor shall provide testing equipment and personnel to randomly re-test 10% or 20 drops minimum, whichever is greater, of all UTP cable locations on the campus in the presence of the designated District Representative and Project Engineer. The District Representative shall choose which cables are to be retested. If 10% of the re-tested cables fail to match the previously submitted original tests, the Contractor must hire an independent testing firm to re-test all UTP cable on the campus, at no cost to the customer. All cables which do not meet the specifications criteria as determined by the independent test report, shall be replaced and retested by the Contractor at no cost to the District. Final sign-off of the testing shall be approved after receipt of all other documentation.

8.34 Multimode fiber optic cables shall be tested bi-directionally at 850nm and 1300nm. Single mode fiber optic cable shall be tested bi-directionally at 1310nm and 1550nm. All fiber strands shall be tested with an OTDR (Optical Time Domain Reflectometer). All fiber test results shall contain final source and destination information that matches IDF or MDF labeling shown on the fiber optic patch panels and final documentation. OTDR test results shall be included with the copper test results and submitted with the tester’s software for review. Do not submit test results for review in Excel or PDF file formats, as the submittal will be rejected and not reviewed.

8.35 Test procedures shall comply with EIA/TIA 526-14 Method B. Test results shall meet the minimum following criteria:

8.35.1 Fiber optic test results shall not exceed 2db total attenuation loss in addition to inherent loss published by manufacturer tested at minimum 2000 Mhz for 850nm and 500 Mhz for 1300nm for the fiber optic cable.

8.35.2 Test all data cables minimum Category-6 UTP cable to test results for “Channel Testing” requirements @ 250 Mhz per current EIA/TIA requirements. Any cables which do not meet these minimum requirements shall be replaced or repaired at no cost to the District.

8.35.3 Test all data cables minimum Augmented Category-6 UTP cable to test results for “Channel Testing” requirements @ 500 Mhz per current EIA/TIA draft requirements. Any cables which do not meet these minimum requirements shall be replaced or repaired at no cost to the District.

8.36 End to end attenuation testing shall be performed with a temporary test jumper cable at each end of the installed fiber cable. The test jumper utilized shall be the same fiber core size and grade of glass as the installed cable. The measured attenuation of the test jumpers, test connectors, and test interconnection sleeve between the two test jumpers shall be less than 1dB as calibrated at the time of the test at indicated wave lengths and frequencies. Test jumpers shall be “zeroed out” before testing of fiber strands begins.

8.37 Contractor shall furnish and install laminated copies of the As-Built Drawings in the MDF/IDF Room, mounted to the backboard at the location determined by the College, showing the location of all devices and outlets, cable routes, cable pathways and all labeling. The laminated drawings shall be full-size to match the project drawings. Coordinate the mounting location with the College IT Department Director.
Final As-Built Drawing Submittals - Provide (1) hard bound copy of “E-size” As-Built drawings and (3) copies on USB Flash Drive in AutoCAD (2014 or newer version) format. A Hand marked-up copy of the original construction drawings will not be accepted as the final As-Built drawing submittal. Final As-Builds shall include copies of the floor plan drawings of each building, detailed elevations of each MDF or IDF locating all equipment, quantities outlets and speaker locations, locations of all sleeves and identification of all final cable routes. In addition, the drawings shall include all outlet locations with cable identification numbers.

END OF SECTION
PART 1 – GENERAL

SUMMARY

1.1 The Contractor shall furnish all labor, project management, materials, tools, equipment, and resources necessary for the installation, startup, and testing of the system shown on the plans and described in the specifications.

1.2 The Contractor shall furnish and install the system as defined by the plans and specifications. The Contractor must demonstrate to the Owner that the system is complete and complies with all operational requirements set forth in the plans and specifications.

1.3 The work covered under this section of the specifications consists of furnishing all labor, equipment, supplies and materials, and in performing all operations necessary for the turnkey and fully completed installation of an audio/video system in accordance with the specifications and accompanying drawings, except as specifically noted otherwise.

1.4 Cables for the system shall be pulled through the conduit systems furnished by the building contractor. The 27 20 00 contractor shall be responsible for providing all cables required and for coordinating and supervising the cable installation. The 27 20 00 contractor shall be responsible for insuring the integrity of the cables before and after installation.

1.5 Work Excluded:

1.5.1 Conduit/raceways, sleeves, cable trays, electrical boxes, hand holes, pullboxes, etc. required for the system shall be furnished and installed by the Division 26 Contractor. The conduit/raceways and electrical boxes furnished and installed under Division 26 shall conform with the requirements of the drawings and specifications for the system.

1.6 In order to ensure project cohesion a single point of contact is required to provide a “TURNKEY” solution. The work covered under this section of the specification consists of furnishing all labor; cabling; equipment; software; supplies; materials and training. The contractor will perform all operations necessary for the “TURNKEY” and fully completed installation in accordance with the specifications herein. As such, the successful contractor must be factory trained on all aspects of system hardware. The successful contractor shall be a California licensed C7 or 10 premise wiring Contractor as defined in this specification. Subcontractors may not be utilized in the implementation of the plant wiring installation.

1.7 Approval to bid shall not release the Contractor from full specification compliance requirements. Final system acceptance testing shall govern final system acceptance and compliance with the specifications.

1.8 Failure to provide a functional equivalent shall result in the removal of the alternate system at the contractor's expense.

1.9 These specifications contain statements which may be more definitive or more restrictive than those contained in the General Conditions. Where these statements occur, they shall take precedence over the General Conditions.
1.10 Where the words 'provide' or 'provision' is used, it shall be definitely interpreted as 'furnishing and installing complete in operating condition'. Where the words 'as indicated' or 'as shown' are used, it shall mean as shown on contract drawings.

1.11 Where items are specified in the singular, this division shall provide the quantity as shown on drawings plus any spares or extras mentioned on drawings or specifications. All specified and supplied equipment shall be new.

DEFINITIONS

1.12 Concealed: Hidden from sight, as in trenches, chases, hollow construction, or above furred spaces, hung ceilings - acoustical or plastic type, or exposed to view only in tunnels, attics, shafts, crawl spaces, unfinished spaces, or other areas solely for maintenance and repair.

1.13 Exposed, Non-Concealed, Unfinished Space: A room or space that is ordinarily accessible only to building maintenance personnel, a room noted on the 'finish schedule' with exposed and unpainted construction for walls, floors, or ceilings or specifically mentioned as 'unfinished'.

1.14 Finish Space: Any space ordinarily visible, including exterior areas.

Contractor Qualifications

1.15 The successful bidder shall be a California licensed C7 or C10 premise wiring contractor as defined in this specification. Subcontractors may not be utilized in the implementation of the installation or programming.

1.16 The successful bidder shall have design staff with a BICSI certified (RCDD) Registered Communications Distribution Designer. The design staff shall also include individuals with CTS certification, and Extron Advanced A/V Certifications.

1.17 The successful bidder shall have installation staff with CTS certification, and be an Extron Certified Control Professional.

1.18 All bidders must provide a listing of two similar size projects having the same scope of work using the proposed information delivery equipment. This listing shall be complete with facility names, completion dates, names of contacts, and their telephone numbers. Referenced projects must have been completed in the past 18 months.

1.19 The bidder shall have a factory trained service department the service department shall be on call 24 hours a day, 365 days a year, to arrive and initiate onsite service the specified equipment upon (24) hours notice.

1.20 The Contractor shall employ factory-trained technical/service personnel for service and maintenance of the system. Their résumés will be required. The factory-trained technical/service personnel shall have a minimum of two years experience installing the proposed system. The Bidder shall submit the names and copies of the certificates issued by the factory. The bidder shall instruct the Owner's technical personnel in the operation, care, and maintenance of the system.

CODE COMPLIANCE

1.21 All material and equipment shall be clearly listed, labeled, or certified by Underwriters Laboratories, Inc. All power supplies and computers shall be clearly UL Listed. Any system which is not UL Listed at time of bid will be rejected.
1.22 All acceptable systems shall be approved under Part 15, Subpart B, Section 15.107b of the FCC Rules and Regulations. Bidders must provide the FCC Registration Number of the proposed system. Systems that are not in compliance with the FCC will not be considered. Any system that is not FCC compliant at time of bid will be rejected. All equipment must be clearly labeled with FCC compliance stickers.

1.23 The system shall be installed in accordance with local and national electrical codes.

1.24 The manufacturer and contractor shall provide the Owner with a release for use of all copyright materials, corporate logos, and corporate trademarks at time of bid.

SUBMITTALS

1.25 Index all submittals and reference to these specifications. All submittal items shall be assembled and submitted in an electronic file per submittal group. Partial submittals will not be reviewed. Submit items in groups as indicated below: All submittals, warranty information, closeout documents, and as built documents must be submitted independently for owner, to provide record documentation for the project owner.

1.26 Group #1 Submittal shall be made within (20) working days after the award of the contract. This submittal shall include the following:

1.26.1 Complete bills of quantities, including all materials, components, devices, and equipment required for this work. The bills of quantities shall be tabulated respective of each and every system as specified, and shall contain the following information for each item listed:

1.26.1.1 Quantity of each type of equipment item
1.26.1.2 Description of each item
1.26.1.3 Manufacturer's Name and Model Number
1.26.1.4 Manufacturer's Specification Sheet or Cut Sheet. Material Cut Sheets shall provide detailed product information and shall be original manufacturer product bulletins. Copies of material information from vendor websites shall not be considered equal and will not be accepted.

1.26.1.5 Material Cut Sheets part number be provided shall be highlighted or provided with an arrow directed at the corresponding part number.

1.26.1.6 Specification Item Number referenced for each required product or if not shown in the specifications, Drawing Detail Number being referenced. (ie; Spec. 271000 Item 2.1 or DWG E4.15/#1)

1.26.1.7 Equipment items which have individual components, will require that all component parts be listed individually.

1.26.1.8 Description of any specialty backbox requirements
1.26.1.9 All wiring types required for installation of this system
1.26.1.10 Copy of equipment warranty
1.26.1.11 Spare parts shall be listed individually to verify proposed quantity
1.27 Group # 2 Submittal shall be provided within (20) working days after the approval of the Group # 1 submittals and prior to any fabrication or field conduit installations. All shop drawings shall be engineered and drawn on a CAD System. Each submission shall include electronic copies to match the contract drawings, and (1) data disk copy with files in a AutoCAD format. Contractor shall make the request for drawings in writing directly to Johnson Consulting Engineers, confirmation of the request and a release form will be forwarded to the contractor to include a signed copy with payment prior to release of files. Detail or riser diagram sheets or any other drawings other than floor or site plans, will not be made available to the contractor. Phase II Submittals drawings shall include the following:

1.27.1 Furnish complete shop drawings for all systems specified. Each drawing shall have a descriptive title and all sub parts of each drawing shall be completely described. All drawings shall have the name of the project, architect, consultant, and electronics contractor in the title block.

1.27.2 Furnish complete scaled drawings of all equipment racks, consoles, special assemblies, etc. Each drawing shall show all equipment with its manufacturer and model number.

1.27.3 Furnish complete scaled installation drawings detailing locations of all equipment such as control panels, plug panels, video monitors, video projectors, equipment racks, speakers, etc. All conduits with cable quantities and types and all terminal block locations shall be shown also.

1.27.4 Provide single line riser diagrams of all racks, consoles, control panels, speaker assemblies, etc. Each drawing shall delineate circuit numbers for all cables and terminal connections. Provide typical wiring termination for all devices.

1.28 Common submittal mistakes which will result in submittals being rejected:

1.28.1 Not including the qualifications of the installing contractor.

1.28.2 Not including all items listed in the above itemized description.

1.28.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.28.4 Not including actual manufacturer’s catalog information of proposed products.

1.28.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

1.29 All equipment items referenced by manufacturer name and model number shall be the only approved product to be furnished for use on this project. Where alternate items are acceptable (or approved alternate) will be noted with the product description.

SEISMIC ANCHORING

1.30 All sound systems, communication, signal or data networking equipment or enclosures shall be anchored to the structure. Where details have not been provided on the drawings, anchorage shall comply with all applicable building codes. The Contractor
shall submit drawings signed by the Contractors registered Structural Engineer indicating method of compliance prior to installation.

CLEANUP

1.31 In addition to cleanup specified under other sections, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any spattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.

1.32 Use steel brushes on exposed metal work to carefully remove rust, etc., and leave smooth and clean.

1.33 During the progress of the work, keep the premises clean and free of debris.

GENERAL COORDINATION

1.34 The A/V drawings may reference components by manufacturer which conflict with the written specification requirements, where this occurs the written specifications shall be followed.

PART 2—PRODUCTS

Information Touchscreen Flat Panels:

2.1 Information Touchscreen Flat Panels- Provide an Interactive flat panel displays on an adjustable wall bracket for Student information and direction in the Student Center Lobby area and the Student Counseling Center. The flat panels shall be tied into the College’s existing Visix Digital Signage System to allow for display of informational channels. Provide all structural support for flat panel and mount assemblies. Provide all necessary audio, video and data cabling as outlined in the drawing details and these specifications. The touchscreen flat panel will include the following features:

2.1.1 High Definition display (1920 x 1080) resolution.

2.1.2 48” panel size

2.1.3 16:9 Aspect ratio

2.1.4 440 CD/m² brightness (minimum)

2.1.5 4000:1 Contrast ratio

2.1.6 178° viewing angle

2.1.7 60 hertz refresh rate

2.1.8 1.07 billion (10 bit) display color

2.1.9 Infrared touch with 10-point simultaneous contact.

2.1.10 Provide with optional OPS PC with AMD eTrinity Architecture - 2.3GHz Quad Core, 128GB Solid State Hard Drive, Model #OPS-PCAEQ-PS with Windows 8.1 Pro Embedded operating system
2.1.11 Inputs - (2) HDMI 2.0 inputs (w/HDCP), (2) Display Port inputs (w/HDCP), (1) DVI-D input (w/HDCP), (1) VGA input, (1) RCA Composite input, (2) 3.5 mm audio inputs, (2) DisplayPort Audio inputs, (2) HDMI Audio inputs, (1) LAN (RJ-45) input, (1) 3.5mm IR Remote Jack, (1) RS-232 input, MicoSD Card slot, USB 2.0 (Service Port), USB-B (Upstream Port), 2.0 x2 (Compute Module, Powered 5V/2A)

2.1.12 Outputs - (1) DisplayPort (Outputs DisplayPort or OPS), (1) 3.5mm Audio out, (1) LAN RJ45 out

2.1.13 Anti-glare surface for high visibility and protective glass providing protection against screen damage.

2.1.14 Provide standard accessories including power cord, USB cabling, remote control, and wall mount kit.

2.1.15 Provide (3) NEC Touchscreen Commercial 48" Display Model #V484-T (or approved equal)

2.1.16 Provide CATV connection to the flat panel where shown on the drawings. Coordinate the installation of the digital receiver from the Cable Provider with the flat panel location. The CATV receiver shall be provided by the College and installed by the Contractor. Coordinate the provision of the receiver with the College IT Department. Provide a 6-foot HDMI cable for the CATV Receiver output to the flat panel. Refer to the Patch Cables section of the specifications for requirements.

2.1.17 Contractor shall furnish and install all Audio-Visual and Ethernet patch cords required for a turn-key installation of the Touchscreen Flat Panel Monitor.

2.1.18 Program the touchscreen function pages per the District’s direction. The programming page shall be submitted to the Project Engineer and the District’s Project Manager for approval prior to final programming. The pages shall be presented as a flow-chart to thoroughly show the exact steps that will be taken to a final resolution. Multiple page set-ups will be required based on the functions required and the integration with the Digital Signage distribution system.

2.1.19 Contractor shall allow for a minimum of 8 man-hours of meetings with the District’s local Administrative Departments in the Student Services Building for input and requirements for the Touchscreen’s functional display and page set-ups.

Flat Panel Installation -

2.2 Provide each of the Touchscreen Flat Panels with a surface mounted dual arm, articulating, Flat Panel TV Mount. Provide Chief Model #PDRUB mount with for each of the locations. In addition, The Contractor shall furnish each location with the Chief adapter bracket (as required) for the Touchscreen Flat Panel Model. Total of (3) locations all necessary brackets and hardware to install per manufacturer’s instructions.

2.2.1 Contractor shall be responsible for the provision and installation of all Flat Panel Mounts. Exact height of all panels must be confirmed by the Project Engineer prior to installation of any mounting components. Contractor shall submit, for approval of locations and mounting heights of panels, an RFI for approval, detailing the mounting proposal prior to installation of any of the mounts.
2.2.2 Contractor shall coordinate the locations of all incoming conduits and power with the Electrical Contractor to the Flat Panel locations, confirming heights and locations of the j-boxes. This will have an impact on the method of mounting the support arm to the wall.

Digital Signage System Requirements

2.3 The College District currently owns the Visix Digital Signage control software and channel distribution system. The Touchscreen Flat Panels shall be provided with the full Visix channel capability and local informational content control via the existing control software. Provide the Visix Media Player at each Flat Panel location for delivery of the Visix Digital Signage System channel content.

2.3.1 Provide Visix High Definition Media Player at each of the Touchscreen Flat Panel locations in the Lobby of the Student Services Building.

2.3.2 Media Player shall be mounted directly behind the flat panel and connected to the Ethernet data port outlet for the network connection. Mount the Media Player to the back of the articulating arm support VESA mounting plate. Provide HDMI patch cable from Media Player to the input on the Touchscreen Flat panel and program the flat panel for controls options. Provide Media Player by Visix Model HDn Media Player.

2.3.3 Contractor shall furnish and install all Category-6 Ethernet patch cables and HDMI patch cables for the Media Player connections.

2.3.4 Contractor shall provide complete turn-key programming for the distribution of the existing Visix Digital Signage channels to the Touchscreen Flat Panels. Coordinate with the District IT Department for access and programming requirements. Program access for the local departments within the Student Services Building to allow for creation of content on the software intended to offer guidance to the students. Contractor shall program any touch functions required to allow for further direction to the students.

Audio/Video Patch Cables

2.3.5 All patch cables shall be provided for each type of connection required to provide a complete and operational system. All patch cables shall be factory manufactured.

2.3.6 HDMI Patch Cables 3-feet in length or less; All HDMI patch cables must be 4K verified and must conform to the HDMI High Speed cable standards. Patch cable shall be Extron HDMI Micro Series High Speed, ultra-flexible patch cables. Length of patch cable shall be either 3 feet or 1.5 feet as required for proper operation.

2.3.7 USB-A 3.0 Patch Cables; Provide a USB 3.0 Type-A patch cable for connection to receiver unit from projector. The patch cable shall be 3-feet in length or less, patch cables shall be as manufactured by Pearstone or approved equal. Patch cables shall be provided for the wallplate connections.

2.3.8 Audio Cable Assemblies 12-feet in length or less; All 3.5mm stereo audio cable assemblies shall be a male to male cable fully shielded cable with 3.5mm bayonet style connectors. Extron Mini Audio Cables Series or equal. Provide minimum length of 3 feet.
2.3.9 Category-6 Patch Cables 10-feet or Less; Category-6 UTP patch cables shall be as manufactured by Belden (no approved equal). Patch cables shall be provided with standard patch cable material.

**Portable ADA Assistive Listening System**

2.4 Contractor shall furnish (1) Portable ADA Assistive Listening Systems Kit that may be used for a Conference Room and other small meeting spaces. The portable system is currently designated for use in Rooms 306, 307 and 316.

2.4.1 Provide for each Kit: A self-contained portable wireless FM transmitter and receivers inside a self-contained carrying case. Portable ADA Assistive Listening system shall be as manufactured by Williams Sound Corporation, Phone 1-800-843-3544. Provide self-contained FM based system Model #FM ADA Kit 37 RCH. System kit shall contain the following items;

2.4.2 (1) PPA T46 transmitter, (4) PPA R37 receivers, (4) HED 027 headphones, (1) MIC 090 Mini Lavali microphone, (1) MIC 049 conference microphone, (1) CCS 029 carrying case, (2) NKL 001 neck loop receiver, (1) ADA wall plaque and (5) BAT 026-2 “AA” batteries

**PART 3- INSTALLATION AND EXECUTION**

3.1 Verify that all electrical requirements including junction boxes, empty conduit and power circuits and receptacles are in place as shown on the drawings.

3.2 Receive, check, unload, handle, store, and adequately protect equipment and materials to be installed as part of the contract. Store in areas as directed by the owner's representative. Include delivery, unloading, setting in place, fastening to walls, floors, ceilings, or other structures where required, interconnecting wiring of system components, equipment alignment and adjustment, and other related work whether or not expressly defined herein.

3.3 Installation practices shall follow "standard broadcast wiring" and installation practices, as excerpted from "Recommended Wiring Practices, “Sound System Engineering”, (2nd Edition) D. Davis, and Performed to the highest standards of acknowledged industry practices. Upon request the A/V contractor shall furnish all equipment and labor to verify the compliance with the following:

**Audio System:**

3.3.1 Signal-to-noise ratio (including crosstalk): 55-dB minimum.

3.3.2 Total harmonic distortion: 0.1% maximum from 30 Hz to 15,000 Hz.

3.3.3 System frequency response: ±1.0 dB, 20 Hz to 20,000 Hz.

3.3.4 Program reproduction system with point-source loudspeakers: Flat response from 63 Hz to 2.5 kHz ± 2-dB, decreasing uniformly from a relative level of 0-dB at 2.5 kHz to a relative level of –10-dB at 10 kHz as measured on axis of loudspeaker.

3.3.5 Sound output capability: Program levels of not less than 100 dB without objectionable distortion, rattles, or buzzes.
3.3.6 Hum and noise is inaudible (below the background noise level of the space) under normal operation and as observed in normal seat locations.

Video System:

3.3.7 Signal-to-noise ratio (peak to RMS, unweighted DC to 4.2 MHz): 55-dB minimum.

3.3.8 Crosstalk (unweighted DC to 4.2 MHz): 45-dB minimum.

3.3.9 Frequency response: ± 0.5 dB to 4.2 MHz.

3.3.10 Line and field tilt: 2% minimum.

3.3.11 Differential gain: 3% maximum.

3.3.12 Differential phase: 2° maximum.

3.3.13 System timing sync coincidence: within 50 nanoseconds.

3.3.14 Color timing: ± 2° at 3.58 MHz.

3.4 Adhere to manufacturer's published specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.

3.5 Where manufacturer does not provide bending radius information, minimum bending radius shall be 10 times cable diameter. Arrange and mount equipment and materials in a manner acceptable to the engineer and the owner.

3.6 Attach cables to permanent structure with suitable attachments at intervals of 48 to 60 inches. Support cables installed above removable ceilings. Install adequate support structures for 10 foot cable service loops at each TC.

3.7 Mark all cables and patch cords or jumpers with permanent, non-handwritten number or letter cable markers within six inches of both ends. All cables shall be marked. Cable marking codes shall correspond to run sheets.

3.8 Furnish screw-type terminal blocks, boards, strips or connectors for cables that interface with racks, cabinets, consoles or equipment modules. Attach wires terminating at screw-type terminals with crimp-on lugs. "Telephone-style" punch down blocks are not acceptable for signal or data wiring.

3.9 Group cables according to signals being carried. To reduce signal contamination, form separate groups for the following:

3.9.1 Power cables.

3.9.2 Control cables.

3.9.3 Video cables.

3.9.4 Camera cables.

3.9.5 Audio cables for signals less than minus 20 dBm.

3.9.6 Audio cables for signals between minus 20 dBm and plus 30 dBm.
3.9.7  Audio cables for signals above plus 30 dBm.

3.9.8  Broadband RF cables.

3.10  Run power cables, control cables, and high level cables on the left side of an equipment rack as viewed from the back. Run other cables on the right side of an equipment rack.

3.11  Cut cables (except video, camera and RGBS cables, which must be cut to electrical length) to the length required by the run. All wire and cable shall be continuous and splice-free for the entire length of run. For equipment mounted in drawers or on slides, provide the interconnecting cables with a service loop of appropriate length.

3.12  Install no cable with a bend radius less than that recommended by the manufacturer.

3.13  Provide strain relief for cables. Provide connectors with metal shell/casings. Provide a minimum of three feet of free cable coiled in a floor pocket. Use spiral wrap to group similar cable types.

3.14  All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels, or equipment enclosures. Tin all terminated shield drain wires and insulate with heat-shrink tubing.

3.15  Land all field loudspeaker wiring entering each rack at terminal devices prior to connection to equipment or devices. Land loudspeaker level control cables at screw or tubular clamp type barrier blocks on the left side of the equipment rack as viewed from the rear. Make all connections to screw-type barrier blocks with insulated crimp-on spade lugs. Size all lugs properly to assure low-resistance connections.

3.16  Separately dress, route and land microphone and line level cables directly to equipment.

3.17  Use only rosin core 60/40 tin/lead solder for all solder connections.

3.18  Lace, tie or harness wire or cable in accordance with accepted professional practice. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Provide service loops where harness of different classes cross or where hinged panels are to be interconnected.

3.19  Patch Panel Assignments: Wire patch panels so that signal “sources” (outputs from) appear on the upper row or a row pair and “loads” (input to) appear on the lower row of a row pair.

3.20  Patch Panel Designation Strips: Use alphanumeric identifications and descriptive information on patch panel designation strips. Number the jack positions in each horizontal row sequentially from left to right. Letter the horizontal jack rows sequentially from top to bottom. Include the alphanumeric identification of each jack on the functional block drawings, and on reproductions of these drawings that shall be mounted in an appropriate location near the patch bays.

3.21  Each major component of equipment shall have the manufacturer’s name, address, model number, and rating on a plate securely affixed in a conspicuous place. NEMA code ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible.

3.22  Upon completion of the work, remove all refuse and rubbish from and about the premises, and leave the relevant areas and equipment clean and in an operational state.
3.23 During the installation, and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such work at no cost to the owner.

3.24 Prior to final acceptance, provide minimum of three complete sets of drawings showing all cable numbers and construction details in accordance with the actual system installation. Revise the device layout drawings to represent actual installation locations and coordinate these with the electrical contractor. The operation manual shall contain all instructions necessary for the proper operation of the installed system and manufacturers instructions. The maintenance manual shall contain all information required for the "proof of performance" as required and all manufacturer's maintenance information.

Inspection and Test upon Completion

3.25 Check out and final connections to the system shall be made by a factory-trained technician in the employ of a manufacturer of the products installed. In addition, factory-trained technicians shall demonstrate operation of the complete system and each major component to the Owner.

3.26 System field wiring diagrams shall be provided to the owner by the system manufacturer prior to completion of the installation.

3.27 All materials and installation shall be guaranteed to be free of defects in material and workmanship for two years after final acceptance of installation and test.

3.28 Upon completion of the installation, four (4) copies of complete operational instructions shall be furnished, complete with record drawings. Instructions shall include part numbers and names, addresses, and telephone numbers of parts source. Final payment shall not be made until operational and maintenance manuals have been received.

3.29 Upon completion of the installation of the equipment, contractor shall provide to the owner a signed statement from the equipment manufacturer that the system has been tested and functions properly according to the specifications.

3.30 The Contractor shall be responsible to provide service within 24 hours (or by mutual consent) after notification by the Owner or his representative, within the hours of 8:00 AM to 5:00 PM from Monday through Friday. Service request forms shall be supplied by the Contractor and the faxing or mailing of such a request form shall constitute notification by the Owner of a service request.

3.31 The Contractor shall provide two "preventative maintenance" service calls, spaced six months apart, for cleaning of all source devices and overall inspection of the system.

PART 4- Training

4.1 Contractor will provide a minimum of 6 clock hours of on-site training for site staff on the Touchscreen and Digital Signage Systems. Training for personnel shall be provided by certified technology specialists. The scope of training shall encompass system operation and procedures. Technician training should include an integrated information overview, media retrieval procedures as well as operation procedures for local control configurations. The contractor shall provide a detailed written outline clearly describing the proposed plan for all training, for approval by the Engineer and Owner's representative.

4.1.1 Training for staff will include basic system concepts. Faculty and staff will need to know how to power on/off the system, and how to access one or more media
resources via remote control. Training should include use and operation of audio/video devices and techniques and trouble-shooting tips. Trainers should incorporate hands-on techniques to maximize staff opportunity to incorporate and develop curriculum that is both meaningful and targeted for their student needs. Clearly written support materials should be provided to all training participants. Manual describing operation and use of the system shall also be provided.

PART 5 - PROJECT CLOSEOUT

5.1 Prior to completion of project, compile a complete equipment maintenance manual for all equipment supplied under sections of this division, in accordance with these specifications and as described below.

5.2 Equipment Lists and Maintenance Manuals:

5.2.1 Prior to completion of job, contractor shall compile a complete equipment list and maintenance manuals. The equipment list shall include the following items for every piece of material equipment supplied under this section of the specifications:

5.2.1.1 Name, model, and manufacturer.

5.2.1.2 Complete parts drawings and lists.

5.2.1.3 Local supply for parts and replacement and telephone number.

5.2.1.4 All tags, inspection slips, instruction packages, etc., removed from equipment as shipped from the factory, properly identified as to the piece of equipment it was taken from.

5.3 Maintenance manuals shall be furnished for each applicable section of the specifications and shall be suitably bound with hard covers and shall include all available manufacturer's operating and maintenance instructions, together with "as-built" drawings to properly operate and maintain the equipment. The equipment lists and maintenance manuals shall be submitted in duplicate to the Architect for approval not less than 10 days prior to the completion of the job. The maintenance manuals shall also include the name, address, and phone numbers of all subcontractors involved in any of the work specified herein. Four copies of the maintenance manuals bound in single volumes shall be provided.

RECORD DRAWINGS

5.4 The contractor shall maintain record drawings as specified in accordance with these specifications, and as noted below.

5.5 Drawings shall show locations of all concealed and exposed conduit runs, giving the number and size of conduit wires. Underground ducts shall be shown with cross section elevations and shall be dimensioned in relation to permanent structures to indicate their exact location. Drawing changes shall not be identified only with referencing CORs and RFI s, the drawings shall reflect all the actual changes made.

5.6 Final As-Built Drawing Submittals - Provide (1) hard bound copy of "E-size" As-Built drawings and (3) copies on USB Flash Drive in AutoCAD (2014 or newer version) format. A Hand marked-up copy of the original construction drawings will not be accepted as the final As-Built drawing submittal. Final As-Builts shall include copies of the floor plan drawings of each building, detailed elevations of equipment installations, quantities video
and audio locations, locations of all interface wallplates and identification of all final cable routes.

END OF SECTION
SECTION 27 51 17

WIRELESS CLOCK SYSTEM

PART 1 – GENERAL

1.1 The Contractor shall provide a new Wireless Clock System as shown on the drawings, and as described in these specifications including all connectors, power supplies, and auxiliary equipment as may be required as specified herein.

1.2 Related Specification Sections:

1.2.1 Section 26 01 00 - General Provisions

1.3 Acceptable clock manufacturers shall be Innovation Wireless (No Approved Equal).

The Wireless Clock System specified is the District Standard. Equipment manufactured by Primex, Inova, Rauland, or any other manufacturers not listed above have been reviewed and are not considered equal or approved for use on this project.

Quality Assurance

1.4 All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections. The Contractor must also provide complete installation of all devices and equipment.

1.5 The Contractor shall be an established Communications and Electronics Contractor that has had and currently maintains a locally run and operated business for at least five years. The Contractor shall utilize a duly authorized distributor of the equipment supplied for this project location with full manufacturer's warranty privileges.

1.6 The Contractor shall guarantee availability of local service by factory-trained personnel from an authorized distributor of all equipment specified under this section. On-Site maintenance shall be provided at no cost to the College District for a period of one (1) year from date of installation unless damage or failure is caused by misuse, abuse, neglect, or accident.

1.7 Deliver products in factory containers. Store in clean, dry space in original containers. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

Submittals

1.8 Phase I Submittal shall be made within (20) working days after the award of the contract by the District. This submittal shall include the following:

1.8.1 Complete bills of quantities, including all materials, components, devices, and equipment required for this work. The bills of quantities shall be tabulated respective of each and every system as specified, and shall contain the following information for each item listed:

1.8.1.1 Quantity of each type of equipment item.
1.8.1.2 Description of each item.
1.8.1.3 Manufacturer's Name and Model Number.
1.8.1.4 Manufacturer's Specification Sheet.
1.8.1.5 Equipment items which have individual components, will require that all component parts be listed individually.
1.8.1.6 Description of any specialty backbox requirements.
1.8.1.7 All wiring types required for installation of this system.

1.9 Common submittal mistakes which will result in the submittals being rejected:

1.9.1 Not including the qualifications of the installing Contractor.

1.9.2 Not including all items listed in the above itemized description.

1.9.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.9.4 Not including actual manufacturer’s catalog information for proposed products.

1.9.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

PART 2 – PRODUCTS

Wireless Clock System


2.2 The KRONOsync Wireless Network Time Protocol (NTP) timekeeping system shall consist of a Master Transmitter located near the center of the campus or at the location shown on the project drawings, an NTP receiver box connected to the LAN and the wireless transmitter, digital clocks, and accessories. Once operational, the transmitter shall keep all system clocks synchronized to the second all day, each day, everyday.

2.3 System shall synchronize all clocks to each other. System shall utilize the NTP technology to provide atomic time to components. Clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.

2.4 The system has an internal clock that will continuously be updated via Ethernet NTP connection. If a NTP failure were to occur, the clocks would continue to be synchronized to the internal clock and would not deviate from one another. Once the NTP time is restored, all clocks would once again be synchronized.

2.5 The system has a fail-safe design so that if a power interruption were to occur, the clocks will continue to operate. Upon the restoration of power, the transmitter will once again communicate with the clocks and normal operation will resume. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Savings Time.

2.6 The system shall incorporate fail-safe design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

2.7 System shall be 100% programmable from the front operation panel with LEDs that indicate power status, and NTP reception. System programming for Time Zone, Frequency, 12 or 24 hour operation and DST on/off must be programmable from the front of transmitter to avoid system movement.
2.8 Clock locations shall be as indicated as the project drawings, and clocks shall be fully portable, capable of being relocated at any time. Specified clocks required a 120V power outlet for operation.

Equipment

2.9 General: The time system shall include a transmitter, a NTP Interface Box, indicating clocks, and all accessories as specified for a complete operational system.

2.10 **Master Wireless Transmitter:** Provide KRONOsyc Model #101005 Transmitter located in the MDF Room, installed on a rack mounted shelf at the top of the equipment rack. Coordinate the location of the Wireless Clock Transmitter with the 27 10 00 Contractor. The LEDs and associated buttons on the front of the Transmitter allow for programming and display of the following operating features;

2.10.1 Shall have an internal clock which will guarantee that the operation of the clocks will continue to be synchronized in the event of a temporary NTP failure.

2.10.2 Time Zones: Display and programming must allow for the selection and display of Time zones for all of North America: Eastern, Central, Mountain, Pacific, Alaska and Hawaii. It must also allow for all international time zone options.

2.10.3 Daylight Saving Time: Transmitter must allow for automatic adjustment of the system, allowing it to be active or inactive.

2.10.4 12hr or 24hr Operation: System must allow for programming of desired method of operation on the face of the transmitter.

2.10.5 Frequency Range: 467.2125- 467.4375 MHz, Narrowband FM, 12.5KHz bandwidth, with 5-Watt transmission power. Transmission range up to 2-miles.

2.10.6 Programming: All programming of operating features must occur on the front of the Transmitter and all changes must be able to be viewed on the digital display as the changes are being made.

2.10.7 Antenna: Shall be used for indoor applications and attached to the rear of the transmitter. No external antenna required.

2.10.8 Power Supply (included with transmitter): Input: 120-volt AC 50/60 Hz, Output: 12-volt DC, 3 Amps.

2.11 Wireless Clock Transmitter Installation

2.11.1 Install the Master Wireless Transmitter on a Contractor furnished full-depth shelf in the 4-Post equipment rack in the MDF Room. Connect the power supply to the transmitter. Provide 4-Post full depth vented shelf by CPI Model ##12700-719 or approved equal. Coordinate location of shelf with 27 10 00 Contractor, as shelf must be installed at the top of the rack to insure proper operation and transmission of the wireless signal. The transmitter’s antenna shall be free and clear from any obstructions and shall not be allowed to make contact with any adjacent metal.

2.11.2 The NTP receiver shall be located next to or sit on top of the Transmitter. Connect the Contractor furnished Category-6 patch cable to the College District furnished ethernet switch in the equipment rack. Connect patch cable to the ethernet port on the back of the NTP receiver. Connect the NTP receiver to the Transmitter with the supplied with the Contractor furnished cable. The NTP receiver does not require individual power supply.
2.11.3 Operational software for the wireless clock system is existing and already installed in other campus locations. Confirm operation of the transmitter and synchronization with the District’s existing clock management software. Coordinate the NTP Receiver’s IP address with the District's IT Department Contact.

2.11.4 Transmission System shall receive Atomic Time information every second from the NTP receiver mounted next to and connected to transmitter. Upon power up and receipt of NTP time, the Transmitter will then transmit NTP synchronized time to all receiving devices programmed to the system frequency. The transmitter and all receiving devices will monitor receipt of NTP time and remain synchronized.

2.12 Wireless Synchronized Clocks

2.12.1 Clocks shall automatically update from the transmitter 6 times a day. 2:00, 6:00, 10:00 AM/PM. Clocks shall be furnished with 120V power cord.

2.12.2 Clocks shall keep operating in synchronized mode if the NTP signal is lost due to failure. Once signal is re-acquired, clocks will resume NTP time synchronization.

2.12.3 Clocks will keep operating as quartz based clocks if there is a transmitter malfunction.

2.12.4 Clocks shall be furnished with dimmable LED display digits.

2.12.5 Provide quantity of clocks indicated on the project drawings plus the quantity of spare clocks as shown in the specifications.

2.12.6 Provide Digital wall mounted wireless clock with a 4-Digit, White LED 2.5"H Display Numbers, with direct 120VAC power connection. Provide Innovation Systems Digital Clock Model #632402.

2.13 Provide a quantity of (2) spare Digital Clocks with mounting accessories. Spare clocks not used shall be delivered to the College District Facilities department Contact.

2.14 Clock Installation: (Perform the following operations with each clock)

2.14.1 Clocks shall not be installed until painting and other finish work in each room is complete.

2.14.2 Set clock to correct time in accordance with manufacturer’s instructions.

2.14.3 Observe clock until valid signs wireless signals are received and clock adjusts itself to correct time.

2.14.4 Install the clock on the wall in the indicated location, plumb, level and tight against wall. Attach using suitable fasteners and mounting bracket as approved by clock manufacturer.

2.15 Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.
2.16 Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

Demonstration

2.17 Provide training to Owner’s representative on setting and adjusting clocks, replacing batteries and routine maintenance.

PART 3 - EXECUTION

Inspection and Test upon Completion

3.1 Check out and final connections to the system shall be made by a factory-trained technician in the employ of a manufacturer of the products installed. In addition, factory-trained technicians shall demonstrate operation of the complete system and each major component to the Owner.

3.2 All materials and installation shall be guaranteed to be free of defects in material and workmanship for two years after final acceptance of installation and test.

3.3 Contact Innovation Wireless at 1-888-559-5565 for any Manufacturer’s Technical Support or replacement parts.

PART 4 - RECORD DRAWINGS

4.1 The contractor shall maintain record drawings as specified in accordance with these specifications, and as noted below.

4.2 Drawings shall show locations of all clocks and transmitters. Drawing changes shall not be identified only with referencing CORs and RFIs, the drawings shall reflect all the actual changes made.

4.3 Final As-Built Drawing Submittals - Provide (1) hard bound copy of “E-size” As-Built drawings and (3) copies on USB Flash Drive in AutoCAD (2014 or newer version) format. A Hand marked-up copy of the original construction drawings will not be accepted as the final As-Built drawing submittal. Final As-Builts shall include copies of the floor plan drawings of each building, detailed elevations of clock installations, quantities and clock locations.

END OF SECTION
ARTICLE 1 - SUMMARY

1.1 This Division of the specifications outlines the provisions of the contract work to be performed as a sub contract under the Division 26 scope of work. Reference the Division 26 Electrical General Provisions for scope of work and general requirements.

1.2 In addition, work in this Division is governed by the provisions of the bidding requirements, contract forms, general conditions and all sections under Division 1 requirements.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section.

1.2 BASIC DEFINITIONS

A. MIRA COSTA CITY COLLEGE shall be hereinafter referred to in this document as Owner and the respondent shall be referred to as Contractor. The term Owner includes direct employees and other appointed Owner agents such as Architects or consultants. These agents may be requested by Owner to represent Owner in undertaking certain project tasks.

B. “Days”: As used in the specifications, the word “days” means calendar days including weekend days.

C. Provide”: As used in the plans and specifications, the word “provide” means to furnish, install, connect, program, test, commission and warranty the subject material or services.

D. Specified Items – Substitutions
   1. “No Acceptable Equal”: The exact make and model number identified in this Specification shall be provided without exception. Where compatibility with existing systems is specified, and where a specific make or model number is not identified, the Contractor shall provide equipment which is compatible with, and equivalent to, existing equipment of the same description and type, and serving the same purpose.
   2. “Or Equal”: An item may be substituted for the specified item provided that in every technical and aesthetic sense, the substituted item provides the same or better capability than the specified item, and is fully compatible with the new or existing systems specified. For expansion of existing systems, the item shall also be approved and fully supported by the existing system manufacturer. The Owner shall be the sole authority to determine the equality of substituted products with specified items.
   3. “Aesthetics”, or “Aesthetic Considerations”: If aesthetic considerations are involved in either the ’or equal’ or ’approved equal’ category, this shall be a consideration in approving or disapproving the proposed substitute. If the proposed substitute is aesthetically unacceptable to the Owner, then the specified, or another technically equal item, shall be provided.

E. “Beneficial Use”: Each component of a system is not considered available for beneficial use until and unless all components and conditions have been fulfilled to make the system fully operational.

1.3 LOCATION AND ACCESS TO PROJECT

A. Project is located at MIRA COSTA CITY COLLEGE: 1831 Mission Avenue, Oceanside, CA 92058

B. Any access using normal highway routing to the facility is acceptable.
C. Permission for access to this campus or facility may be revoked for any and all persons who violate facility traffic regulations including speed limits, parking restrictions and directions of the responsible Owner or project personnel. Contractor's personnel, operating forces, and delivery personnel shall be made aware of and shall comply at all times with the regulations and the direction of responsible Owner and project personnel.

1.4 SITE ACCESS CONTROL

A. The Contractor shall obtain rules and regulations from the Owner’s Project Manager and shall train construction and delivery personnel on their requirements. Contractor shall consistently remain in contact with the Owner for revisions to project policy, and shall be held fully responsible for monitoring and ensuring Contractor and Subcontractor compliance to MIRA COSTA CITY COLLEGE Access Control rules and regulations as directed by the Owner.

B. Contractor’s personnel, operating forces, and delivery personnel shall strictly follow all rules and regulations concerning Access Control at the site, including but not limited to those relating to credentialing, background checks, and access to restricted and secure areas, parking, the handling of Access Control information, and the use of the facility.

1.5 DESCRIPTION

A. General Description: This specification section covers general requirements for the furnishing, installation and testing of a complete expansion to the Owner’ electronic access control and Intrusion detection system.

B. Furnish and install Electric Access Control System (EACS) software programming, hardware devices, mounting brackets, power supplies, switches, equipment cabinets, controls, consoles, and other components of the system as shown and specified.

C. Furnish and install Electronic Intrusion Detection (EIDS) software programming, hardware devices, power supplies, and other components of the system as shown and specified.

D. .

1.6 SCOPE OF WORK

A. Systems: Provide an Electronic Access Control System (EACS) and Electronic Intrusion Detection (EIDS) with acceptable engineering and installation practices as described herein.

B. Areas of work include, but are not limited to:
   1. Shop Engineering and Documentation
   2. Wiring and Installation Diagrams
   3. Submittals
   4. Coordination
   5. System Installation
   6. System Integration
   7. Training
   8. Start-up Testing
   9. Commissioning
   10. Close out As-Build documentation
   11. Warranty
1.7 BID RESPONSE

A. Bidders Responsibility
1. Contractor is responsible for verifying actual conditions by visiting the site, reviewing the Specifications and drawings, and to advise the Owner in writing of any conditions which may adversely affect the work. If any necessary exceptions are discovered, Contractor shall immediately notify the Owner for resolution prior to any change in the design or the scope, and any resultant claim for additional compensation.
2. The Bid Response must fulfill the intent of the Drawings and Specifications to the satisfaction of the Owner to qualify as an acceptable Bid Response.

B. Substitutions
1. Catalog and/or model numbers for Owner approved equipment and systems are included as a part of these specifications.
2. Any substitution proposed by Contractor for catalog numbers and brands or trade names noted or specified herein shall be solely at the Contractors risk. The Owner maintains sole authority to hold a review of substitutions, and sole authority to approve or disapprove of substitutions for any reason.
3. The Owner’s acceptance of substitutions shall not relieve Contractor from complying with the requirements of the drawings and Specifications. Contractor shall be responsible, at Contractor’s sole expense, for any changes resulting from Contractor’s substitutions that affect other parts of Contractor’s own work or the work of others.

C. Technical Bid Submission: At bid submission, submit one (1) copy of the following
1. An equipment list with names of Manufacturers of primary systems (EACS & EIDS) including model numbers and technical information on equipment proposed.
2. A letter from the manufacturer(s) stating that the system Contractor is an authorized distributor or installer of the proposed primary systems (EACS & EIDS).
3. Indicate complete and total compliance with the provisions of these Specifications by letter or by submittal of the bid response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. If there are exceptions to the specifications, submit a statement listing every technical and operational parameter wherein the submitted equipment or system may vary from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted, but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter must replace or modify such equipment at once and without cost to the Owner.
4. Failure of Contractor to submit the above information shall be considered non-responsive to the bid requirements and sufficient cause for bid rejection.

D. Examination of Site and Verification of Existing Conditions
1. Contractor shall have visited the site and familiarized himself with existing conditions prior to submitting his bid and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve Contractor of his responsibilities nor entitle him to additional compensation for work overlooked and not included in his bid.
2. Existing structures and utilities shown on the contract drawings are obtained from project drawings and exploratory field examination. Contractor shall verify existing conditions and required dimensions, including those shown on the drawings, by measurement at the job site. Contractor shall notify the Owner of exceptions before proceeding with the work.
3. Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and drawings as necessary. Where proper power does not exist, Contractor shall identify this situation to the Owner for guidance. Should the Owner direct Contractor to provide the necessary power, it shall be provided using equipment and methods authorized by the Owner.

E. Data Accuracy: Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of Contractor and exact locations, distances, and elevations will be governed by actual field
1.8 QUALIFICATIONS

A. General
1. The approved Contractor shall be responsible for satisfactory operation of the system and its certification.
2. Approval of the Owner is required of products or services of the proposed manufacturer, suppliers and installers and will be based upon conformance to the specifications.

B. Manufacturer Qualifications
1. System components shall be furnished by manufacturers of established reputation and experience who shall have produced similar equipment and who shall be able to refer to similar installations rendering satisfactory service.
2. The manufacturer's products shall have been in satisfactory operation on at least three similar installations for not less than three years. Contractor shall submit a list of similar installations.
3. Components including, but not limited to, card access controllers, cameras, intercoms, computers, and power supplies shall have been tested and listed by Underwriters Laboratories, Inc., Factory Mutual Systems, or other approved independent testing laboratory.
4. Components installed within a common enclosure shall be approved by an agency recognized by the local city Department of Building and Safety as an assembly.

C. Contractor Qualifications
1. Hold current legally required California State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. Contractor shall submit copies of licenses to Owner prior to the start of work.
   a. C-10 and C-28 licenses are required.
2. Hold current legally required state registrations required to meet local requirements for submittal drawings.
3. Have manufacturers trained and certified engineering, field technicians and programming staff.
4. Indicate complete and total compliance with the provisions of these Specifications by letter or by submittal of the bid response forms, signed by an officer of the corporation, or a principal if other ownership exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.9 PHASING PLAN

A. The work shall be performed in phases.
1. Each phase of work shall include, but not be limited to the provision of applicable conduit, power, equipment, programming, and documentation to provide a complete, operational system, as described herein.
2. Coordinate work phasing with the Owner.
3. Within 14 days after award of the project, submit a preliminary phasing plan to the Owner for review. The Shop Drawings shall reflect the process of the phasing plan.

B. Phasing Plan: The proposed phasing plan should address the scope with the following approach:
1. Install or coordinate with the Owner on the installation of the required network connectivity.
2. Install, power, and test the control equipment, including but not limited to EACS controllers, EIDS panels, computer workstations, and application software.
4. Install cable, and devices which replace existing devices. Connect to controls, and test.
5. Program, configure, test and commission the system as required by the Owner and these specifications.

C. Modifications to the Phasing plan may be submitted by the Contractor, after the Shop Drawings and Equipment Submittals have been reviewed and accepted for installation. The Contractors’ modified phasing plan shall be based upon Contractor’s actual proposed equipment, project schedule and installation planning. The proposed phasing plan shall be designed to achieve the same goals as the phasing plan contained herein, including but not limited to, the successful upgrade of existing Access Control systems while maintaining full Access Control at the facility. The Contractors’ plan must be accepted by the Owner prior to any demolition or installation of equipment and cable. The Owner reserves the right to modify the proposed plan, or any part thereof.

1.10 GENERAL CONDITIONS

A. Contract Compliance: Provide the Systems and Services in accordance with the conditions and system descriptions as described in Part 1 of each specification section. Provide specified or Owner approved equivalent alternate products as described in Part 2 of each specification section. Utilize specified procedures and practices as described in Part 3 of each specification section.

B. Codes: Furnish material and workmanship for this work in conformance with applicable legal and code requirements.

C. Inclusive Work: Provide sufficient time, material, and manpower to verify, revise or refine the Bid Drawings as necessary to develop fully engineered Shop Drawings as required by the General Requirements, and in order for this work to realize complete, stable and safe operation.

1.11 RELATED WORK

A. General
1. Observe interface procedures to related work.
2. Coordinate with the Owner on aspects of aesthetic interface.
3. Coordination: Coordinate this work with related work by other contractors.
4. Coordinate with existing construction, equipment, and field devices.
5. Equipment provided under this project shall be installed in a manner consistent with architectural, operational, service and maintenance considerations.
6. "Coordinate" related work not specifically mentioned below.

B. Owner’s General Provisions and Work Contract

C. Division 01, General Requirements: Coordinate this work with applicable sections of the Owner’s General Requirements and General Provisions.

D. Division 08, Openings: Coordinate this work with applicable sections of Division 08, Openings, including but not limited to the following.
1. Schedules for Openings: Coordinate Access Control requirements with door, frame, and hardware schedules.
2. Section 08 70 00 – Hardware, and MIRA COSTA CITY COLLEGE guidelines for door hardware.
3. Door hardware, door and frame modifications shall be provided by the Security Contractor. Security Contractor shall coordinate with the Owner on requirements and interfaces with Access Control hardware.
4. Access Doors: Coordinate with the Owner for the provision of access doors where needed to gain access to wiring, boxes, panels and enclosures in walls or ceilings.

E. Finishes: Coordinate this work with applicable Owner requirements for Finishes, including but not limited to the following.
   1. Painting/Patching: Provide painting, patching and repair services to match existing conditions.
   2. Painting of walls shall be from corner of nearest wall across repair area to nearest wall on opposite side of repair area.

F. Division 14, Conveying Equipment: Coordinate this work with applicable Owner requirements of Conveying Equipment, including but not limited to the following.
   1. Owner’s requirements for Elevator Equipment and Controls.
   2. Elevator work shall be provided by the Contractor.
   3. Contractor shall coordinate with the Owner on requirements and interfaces with elevator equipment.

G. Division 26, Electrical
   1. Coordinate this work with applicable sections of Division 26, Electrical, including but not limited to the following:
      a. Electrical power distribution sources for existing buildings shall be by the Owner unless otherwise noted. Contractor shall coordinate with the Owner to identify and verify 120-volt power service requirements with the first shop drawing submittal.
      b. Conduit, boxes, and rough-in material shall be provided and installed by the Electrical Contractor, unless otherwise noted.
      c. Specialty boxes shall be provided by the Security Contractor and installed by the Security Contractor, unless otherwise noted.

H. Division 27, Communications
   1. General: Coordinate this work with applicable sections of Division 27, Communications, including but not limited to structured cabling, fiber optic cabling, telephone, and data communications requirements.
   2. Contractor shall coordinate with the Owner to identify and verify shared cable/pathway, LAN ports, and bandwidth requirements at the time of the first shop drawing submittal.

I. Division 28, Electronic Safety, and Access Control
   1. Section 28 05 00 – Security System General Requirements
      a. Provide equipment and services required by related Sections pursuant to the requirements of Section 28 05 00, Security System General Requirements.
   2. Section 28 05 53 – Identification for Electronic Safety and Security
      a. Provide equipment and services required by related Sections pursuant to the requirements of Section 28 05 53, Identification for Electronic Safety, and Security.
   3. Section 28 07 00 – Security System Integration
      a. Provide equipment and services required by related Sections pursuant to the requirements of Section 28 07 00, Access Control System Integration.
   4. Section 28 08 00 – Testing and Commissioning
      a. Provide equipment and services required by related Sections pursuant to the requirements of Section 28 08 00, Testing and Commissioning.
   5. Section 28 13 00 - Electronic Access Control System
      a. Provide equipment and services required by Section 28 13 00, Alarm, and Access Control System, pursuant to the requirements of this section.

J. Coordinate related work with door hardware including but not limited to automatic motorized gates and door openings, power assisted door opening and powered panic hardware.
1.12 PRECEDENCE

A. If any statement in this or any other Division 28 specification is in conflict with any provision of the General Terms and Conditions of the contract, the provision stated in the General Terms and Conditions shall take precedence. Any questions that result from such potential conflict, which require additional interpretation and guidance shall be immediately brought to the Owner’s attention.

B. Obtain, read and comply with Division 26, Electrical and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable Division 26 sub-sections and directions as contained herein, this section shall govern.

C. Architectural drawings shall have precedence over other drawings in regard to dimensions and location.

1.13 APPLICABLE PUBLICATIONS

A. The edition of the appropriate code or standard at the time of permitting shall govern all applications.

B. Standards: Perform the work in accordance with the following standards:
   1. UL Underwriters Laboratories, Inc., UL 294, UL 1076, ULC
   2. EIA Electrical Industries Association.
   3. NTSC National Television Standards Committee.
   4. NEMA National Electrical Manufacturers Association.
   5. NECA National Electrical Contractors Association, Standards of Installation.
   7. CCR Title 24 California Building Code
   8. CCR Title 24 California Electric Code
   9. ADA standard NTSC (color camera broadcast)

C. Where more than one code or regulation is applicable, the more stringent shall apply.

D. Cable installation, identification and termination shall be performed in accordance with manufacturer’s installation manuals in addition to the above applicable codes.

E. In the absence of manufacturer’s recommendations on conductor applications, the Contractor shall ensure that the cable selected meets all technical requirements of the location of its installation, and of the equipment to be installed.

1.14 SHOP DRAWING & EQUIPMENT SUBMITTAL

A. General: Bid documents, including drawings, details and specifications are considered conceptual in nature, and provide direction on products and project requirements. Contractor is given a choice of methods that may be incorporated into the system. These choices may affect the overall design, configuration, and installation of the proposed system.

B. Contractor Responsibility: Prepare and submit shop drawings, rendered in the latest AutoCad or Revit format, which show details of all work to insure proper installation of the work using those materials and equipment specified or allowed under the approved plans and specifications. A complete Shop Drawing submittal package shall consist of Drawings, Equipment Data Sheet Submittals, and an Acceptance Testing Plan.

C. Completeness: The Equipment Submittals, Acceptance Testing Plan and the Shop Drawings should be submitted as a complete and contiguous package. Partial or unmarked submittals will not be accepted for review.
D. Scheduling: A schedule of shop drawing submissions shall be submitted for the Owner’s review on a form acceptable to the Owner within ten (10) days after award of the Contract. The schedule of shop drawing submissions shall include as a minimum, but not limited to the requirements stated herein.

E. Requirements: Provide the following information complete, and in the manner described herein:

1. Hardware, Application Software, and Network Requirements: A system description including analysis and calculations used in sizing equipment required by the security systems. The description shall show how the equipment will operate as a system to meet the performance requirements of the systems. The following information shall be supplied as a minimum:
   a. Server(s) processor(s), disk space and memory size and/or expansion of existing
   b. Workstation(s) processor(s), disk space and memory size
   c. Description of site (field) control equipment (Controllers/Field Panels, NVR’s, Modules) and their configuration
   d. Operating System(s) Software, where software is provided or upgraded
   e. Application Software, with Optional and Custom Software Modules supplied in this project
   f. Integration Schemes: Proposed connectivity, software, development requirements, and SDK information, for inter-system communication.
   g. Network bandwidth and reliability requirements
   h. Number and location of LAN ports required
   i. Other specific network requirements, preferences, and constraints
   j. Backup/archive system size and configuration
   k. Start-up operations
   l. System power requirements and Uninterruptible Power Supply (UPS) sizing
   m. Device/component environmental requirements (cooling and or heating parameters)

2. Shop Drawings: Shop Drawings shall be numbered consecutively and shall accurately and distinctly present the following information:
   a. Title Sheet:
   b. Floor Plans: Showing devices, pull boxes, cabinets, conduits, and conductors in their proposed locations with device numbering scheme.
   c. Riser Diagram: Showing all conduit relationships between devices shown on the Floor Plans. Show all power sources.
   d. Single-Line/Block Diagrams: Show signal relationships of controls and devices within the system.
   e. Custom Assembly Diagrams: For each custom assembly, such as Access Control Terminal Cabinets, receptacle assemblies, or door control panels, provide an assembly drawing illustrating the appearance of the assembled device. Include dimensions, assembly components, and functional attributes (momentary or alternate action switch, lens color, panel finish)
   f. Component Connection Diagrams:
      1) For each equipment component, such as a computer, video switcher, camera or video recorder, show the rear elevation of the device and all connectors/terminations as a pictorial.
      2) Show the wire designations on connectors. Typical wiring detail where multiple of same device is provided.
      3) Show a schedule of the wire colors connected to the pins on each device connector
   g. Equipment Wiring Diagrams:
      1) Show a pictorial illustration of each equipment enclosure and/or terminal cabinet, including terminals, components, and wiring devices.
      2) Show the device nomenclature exactly as shown on the single line diagrams.
      3) Terminations: Show every termination and terminating cable, with applicable cable and wire numbers matching the single line diagrams.
         a) Every termination in the system must be documented.
b) Termination information may be rendered as a wiring list(s), if properly coordinated with, and referenced to, typical component and single-line diagrams. Otherwise, the Shop Drawings shall show a pictorial of every component in the system, with its terminations.

4) Show wire colors for each terminal.
5) For each wire exiting the enclosure, show the destination of the wire by floor, room number and the drawing number of the panel where the wire terminates.

h. Provide working dimensions and erection dimensions.
i. Arrangements and sectional views
j. Necessary details, including complete information for making connections between work under this Contract, existing work, and work under other Contracts.
k. Stock or standard drawings will not be accepted for review unless full identification and supplementary information is shown thereon in ink or typewritten form.
l. Duplicate of design drawings may be used where each sheet is modified to reflect contractor coordination, specific requirements of the project and multidiscipline conditions.
m. Each Drawing or page shall include:
   1) Project name, Project Number, and descriptions.
   2) Submittal date and space for revision dates.
   3) Identification of equipment, product, or material.
   4) Name of Contractor and Subcontractor.
   5) Name of Supplier and Manufacturer.
   6) Relation to adjacent structure of material.
   7) Physical dimensions, clearly identified.
   8) ASTM and Specifications references.
   9) Identification of deviations from the Contract Documents.
   10) Contractor's stamp, initialed or signed, dated and certifying to review of submittal, certification of field measurements and compliance with Contract.
   11) Location at which the equipment or materials are to be installed. Location shall mean both physical location and location relative to other connected or attached material.

3. Equipment Submittals
   a. Provide a Title Page, with project name, Contractors name and address, contact information, date of submission, and submission revision number.
   b. Provide a Parts List, for proposed equipment, materials, components and devices, listing the following information for each line item:
      1) The system type
      2) Model number
      3) Specification sheet page reference
   c. Provide Manufacturers Specification Sheet with descriptive information for equipment, materials, components, and devices. Number each page, to correspond with the Parts List.
   d. Clearly delineate (with highlighter, arrow, or underline) on each specification sheet, specific model numbers, options and configurations being proposed for this project.
   e. Indicate kinds of materials and finishes for equipment where more than one option is presented.

4. Acceptance Testing Plan
   a. Submit a written document detailing the test procedures to be followed in evaluating and proving the installed system(s).
   b. Provide a sample of the test forms to be used for each system and for each component of each system.
   c. Include all tests required by the equipment manufacturer and by this Specification.

5. Spare Parts List: Submit a list of recommended spare parts. Spare parts shall comprise a minimum of 5% or minimum of 2 each of field devices, device termination boards and a minimum of 1 system controller boards.

6. Training Program
a. Submit a training program 10 working days prior to scheduled training to be followed in training key employees in the operation and maintenance of the installed system at the project site. The proposed training program shall be designed to provide a level of basic competence with the system for selected personnel. These selected personnel shall then be expected to train other personnel as required, utilizing the training that they have been given and the body of training documentation provided by Contractor. This plan shall comply with the requirements stated in the “Training” section of these Specifications, all stated hours of which shall be considered to be classroom hours.

b. Submit a curriculum to account for, and relate, each subject to actual training time. All required hours shall be accounted for in this curriculum.
c. The training plan shall cover the overall system, each individual system, each subsystem, and each component. The plan shall also cover procedures for database management, normal operations, and failure modes with response procedures for each failure. Each procedural item must be applied to each equipment level.

F. The Owner will return unchecked any submittal which does not contain complete data on the work and full information on related matters.

G. Verification: The contractor shall check and acknowledge all shop drawings, and shall place his signature on all shop drawings submitted to the Owner. Contractor's signature shall constitute a representation that all quantities, dimensions, field construction criteria, materials, catalog numbers, performance criteria and similar data have been verified and that, in his opinion, the submittal fully meets the requirements of the Contract Documents.

H. Timeliness: The Contractor shall schedule, prepare, and submit a complete shop drawing assembly in accordance with a time-table that will allow his suppliers and manufacturers sufficient time to fabricate, manufacture, inspect test and deliver their respective products to the project site in a timely manner so as to not delay the complete performance of the work.

I. Departure from Contract Requirements: If shop drawings show departures from the Contract requirements, the Contractor shall make specific mention thereof in his letter of transmittal, otherwise review of such submittals shall not constitute review of the departure. Review of the drawings shall constitute review of the specific subject matter for which the drawings were submitted and not of any other structure, materials, equipment, or apparatus shown on the drawings.

J. Contractor Responsibility: The review of shop drawings will be general and shall not relieve the Contractor of responsibility for the accuracy of such drawings, nor for the proper fitting and construction of the work, nor for the furnishing of materials or work required by the Contract. No construction called for by shop drawings shall be initiated until such drawings have been reviewed and approved.

K. Shop Drawing Submittal Review: The procedure in seeking review of the shop drawings shall be as follows:
   1. The Contractor shall submit four (4) complete sets of shop drawings with equipment submittals and other descriptive data with one copy of a letter of transmittal to the Owner for review thirty (30) working days after award of the contract. The letter of transmittal shall contain the project name, the Owner’s Project Number, the name of the Contractor, the list of drawings submitted including numbers and titles, requests for any review of departures from the contract requirements and any other pertinent information. Drawings submitted for review shall be full-sized drawings, rolled and included with the equipment submittals.
   2. Drawings or descriptive data will be stamped "Reviewed", "Furnish as Corrected", "Revise and Resubmit", "Rejected" or 'Submit Specific Item' and one copy with a Letter of Transmittal will be transmitted to the Contractor with the return of submitted documents.
3. If a shop drawing or data is stamped "Reviewed" or "Furnish as Corrected", no additional submittal is required for that shop drawing.

4. If a shop drawing or data is stamped "Revise and Resubmit" or "Rejected", the Contractor shall make the necessary corrections and resubmit the documents as required above. The letter transmitting corrected documents shall indicate that the documents are resubmittals.

5. If any corrections, other than those noted by the Owner, are made on a shop drawing prior to resubmittal, such changes should be pointed out by the Contractor upon resubmittal.

6. The Contractor shall revise and resubmit the shop drawing as required, until they are stamped either "Reviewed" or "Furnish as Corrected."

7. After the Contractor's submittal or resubmittal of shop drawings, the Owner shall be provided with fifteen (15) working days for review. Should the Owner require additional review time above and beyond the stated fifteen (15) working days, the Contractor may ask for a time extension and/or monetary compensation, if they can present valid, factual evidence that actual damages were incurred by the Contractor. The Owner shall determine the amount of the time extension and/or the monetary compensation to be awarded the Contractor.

8. The Owner will not issue a "Notice to Proceed" until shop drawings are reviewed, unless otherwise approved by the Owner.

L. The Contractor shall be responsible for extra costs incurred by the Owner caused by the Contractor's failure to comply with the procedure outline above.

1.15 OPERATING AND MAINTENANCE MANUALS: RECORD DOCUMENTS

A. Phase One: Notwithstanding requirements specified elsewhere, submit the following labeled as the "Operating and Maintenance Manual" within thirty (30) days after Final Acceptance of the Installation:

1. Record Drawings: Submit two (2) copies of revised versions of drawings as submitted in the "Shop and Field" and "Equipment Wiring Diagrams" Submittals showing actual device locations, conduit routing, wiring and relationships as they were constructed. Include nomenclature showing as-built wire designations and colors. Drawings shall include room numbers coinciding with Owner space planning numbering. Drawings shall be submitted in electronic editable AutoCAD or revit files, in "dwg" or "rvt" format, on CD or DVD disks.

2. Manuals: Submit two (2) copies of each of the following materials in bound manuals, or electronic PDF copies on CD/DVD discs, with labeled dividers:
   a. A final Bill of Material for each system.
   b. Equipment Instruction Manuals: Complete, project specific comprehensive instructions for the operation of devices and equipment provided as part of this work.
   c. Manufacturers Instruction Manuals: Specification sheets, brochures, Operation Manuals, and service sheets published by the manufacturers of the components, devices and equipment provided.
   d. Include information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.
   e. Provide a replacement parts list with current prices. Include list of recommended spare parts, tools, and instruments for testing and maintenance purpose.
   f. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.
   g. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturers’ Warranty Registration papers as described herein.

B. Phase Two: Within fourteen (14) days of receipt of engineer reviewed Operating and Maintenance Manual (Phase One), submit three (3) electronic copies in AutoCAD editable
The contractor shall provide to the Owner one (1) copy of new executive and user software, including required graphical maps, on CD-ROM disks.

2. Sufficient information, (detailed schematics of subsystems, assemblies, and subassemblies to component level) clearly presented, shall be included to determine compliance with drawings and specifications.

1.16 CHANGES

A. Before proceeding with changes or claims for extras, Contractor shall provide written notice, secure prior written approval from the Owner, and substantiate actual cost of each change or claim.

1.17 NOTIFICATION

A. Contractor shall not shut off any existing systems. Contractor shall give the Owner at least 14 calendar day notice of any requirement to shut off or interfere with existing alarm, access control, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. Work such as splicing, where approved, and connections necessary to establish or re-establish any system shall be completed by Contractor in close coordination with the Owner.

1.18 INTERFERENCE WITH THE FACILITY

A. Transportation and storage of materials at the facility, work involving the facility, and other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference’s, and at times and in a manner acceptable to the Owner. Contractor shall make every effort to deliver equipment per the schedule required by the project.

1.19 WARRANTY

A. Furnish and guarantee maintenance, repair and inspection service for the system using factory trained authorized representatives of the manufacturer of the equipment for a period of one year after final acceptance of the installation.

B. Third Party Device warranties are transferred from the manufacturer to the contractor, which may then transfer third party warranties to the Owner. Specific third party warranty details, terms and conditions, remedies, and procedures, are either expressly stated on, or packaged with, or accompany such products. The warranty period may vary from product to product. These products include but are not limited to devices that are directly interconnected to the field hardware or computers and are purchased directly from the manufacturer. Examples may include but not be limited to; servers, cameras, video recorders, card readers, and computers.

C. Purpose

1. The Contractor shall repair any system malfunction or installation deficiency discovered by the Owner during the burn in and warranty period.

2. The Contractor shall correct any installation deficiencies found against the contract drawings and specifications discovered by the Owner during the warranty period.

D. The service contract shall cover equipment and software related to this contract, and shall provide for the following parts and services, without additional cost to the Owner:
1. Quarterly Inspection, Preventative Maintenance and Testing of equipment and components
2. Regular Service, Emergency Service, and Call-Back Service
3. Labor and Repairs
4. Equipment and Materials

E. Response Time: Response time for service calls.
   1. Emergency service calls where system is not responding to staff directed commands through the computer systems shall be within 2 hours to the project site.
   2. Emergency service calls where controllers are not reporting shall be within 2 hours to the project site.
   3. Normal service calls for device malfunctions shall be within 24 hours during normal working hours to the site.

F. Repair Time: Contractor shall stock parts in sufficient quantities such that repair or replacement shall be guaranteed within 12-hours. Temporary replacements within this time period shall be acceptable, provided temporary replacements do not compromise system functionality, and provided permanent replacement is achieved within 72 hours. Contractor may contact owner for use of owner supplied spare parts where delay of system repair will have negative impact on system performance.

G. Commencement: The warranty begins at the time of issuance of the statement of "Final Acceptance of the Installation" by the Owner.

H. Transferability: The warranty shall be transferable to any person or persons at the discretion of the Owner.

I. Transmittal: A copy of this Warranty shall be delivered to, and signed for by the Owner. A copy of the signed Warranty document shall be delivered for review as part of the Final Submittals.

J. Registration: Register Warranty papers for all equipment and software in the name of the Owner. Furnish reproductions of all equipment Warranty papers to the Owner with the Final Submittals.

K. Sub-Contracting: Warranty service work may not be sub-contracted except with specific permission and approval by the Owner.

L. Resolution of Conflicts
   1. The Owner retains the right to resolve unsatisfactory warranty service performance at any time by declaring the work unsatisfactory, stating specific areas of dissatisfaction in writing.
   2. If the Contractor or his approved subcontractor does not resolve such stated areas of dissatisfaction within thirty (30) days, the Owner may appoint any alternative service agency or person to fulfill the terms of the Warranty; the cost of which shall be borne by the contractor. This action may be taken repeatedly until the Owner is satisfied that Warranty service performance is satisfactory. Satisfactory resolution of a malfunction shall be considered adequate when the device, equipment, system, or component which is chronically malfunctioning is brought into compliance with the standards of performance as contained herein and published by the manufacturers of the equipment installed.

1.20 PERMITS AND INSPECTIONS

A. Responsibility: Obtain permits and inspections required for the work. Permit and inspection costs will be borne by the Contractor.
B. **Performance:** Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of any legal authority having jurisdiction.

C. **Review:** Obtain approvals from authorities responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with all requirements of reference codes indicated herein and required by the appropriate jurisdiction. Make corrections, changes, or additions as required and deliver certificates of acceptance, operation, and/or compliance with the "Operating and Maintenance Manuals" as described herein.

### 1.21 TRAINING

**A. On-Site Training**

1. **General:** Present, review and describe equipment and materials to the Owner and Owner's operating personnel and fully demonstrate the operation and maintenance of the systems, equipment and devices specified herein.

2. **Training shall comprise two separate levels of training;**
   a. **User Group upon substantial completion of the project**
      1) User group training shall include a site/building walk through indicating locations of equipment and their usage
      2) User group training shall include the operation of workstation capability of system monitoring, command override and report generation.
   b. **Maintenance Group upon completion of the project prior to close out**
      1) Maintenance group training shall include a site/building walk through indicating locations of equipment and their usage
      2) Review of as-build documentation at each controller location
      3) Trouble shooting techniques in hardware and software

3. The training shall cover the overall system, each individual system, each subsystem, and each component. The training shall also cover procedures for database management, normal operations, and failure modes with response procedures for each failure. Each procedural item must be applied to each equipment level.

4. **Duration:** Provide at least 2 hours of on-site training on each system for each group of designated representatives of the Owner at a location convenient to the Owner.

5. **On-site training shall commence as follows:**
   a. **EACS:** Just prior to completion of the first phase of work which establishes the new EACS control over entry and exit portals.
   b. **EIDS:** Just prior to completion of the first phase of work which establishes the new EIDS control over monitored doors and devices.

**B. Security Contractor shall provide (10) ten hours of staff training and also provide 3 CEUs of Lenel Global Education Classroom Training for the Owner. Coordinate with Owner as to who will be attending, exact dates and location and specific classes / topics and any other relevant information related to training.**

### 1.22 SAFEGUARDS AND PROTECTION

**A. Barriers:** Provide and maintain suitable barriers, guards, fences and signs where necessary to accommodate the safety of others relative to and/or for the protection of this work.

**B. Regulations:** Comply with OSHPD (where applicable), OSHA, Federal, State, and local regulations and standards pursuant to this work.
C. Protection: Protect all materials and equipment to prevent the entry or adhesion of any and all foreign material. If necessary, cover equipment with temporary protective material suitable for this purpose.

D. Finishing: Check, clean and remove defects, scratches, fingerprints, and smudges if necessary from all equipment and devices immediately prior to Acceptance of the Installation.

E. Damage: Replace all damaged or defective material or work at no additional cost prior to Final Acceptance.

F. Documentation: Provide written description of accidents by workers, students and staff of any incident occurring on the project. Report incident in writing to Owner immediately and to the Project Manager for follow up.

1.23 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery: Unless otherwise noted, pre-testing or configuration is required by the contractor, deliver materials to the job site in manufacturer's original unopened containers, clearly labeled with the manufacturer's name and equipment model identification number.

B. Storage and Handling: Store and protect equipment in a manner which will preclude damage.

1.24 EQUIPMENT COMPATIBILITY REQUIREMENTS

A. While individual items of equipment may meet the equipment specifications and in fact meet the system specifications, the total system shall be designed so that the combination of equipment actually employed does not produce any undesirable effects such as signal distortion, noise, transients, or crosstalk interference’s when electrically associated with itself or other equipment.

1.25 OWNER’S RIGHT TO USE EQUIPMENT

A. The Owner reserves the right to use equipment, material and services provided as part of this work prior to Acceptance of the Work, without incurring additional charges and without commencement of the Warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

A. These general criteria shall apply to “Part 2-Products” of all Access Control specifications that are a part of this work.

B. Product Acceptability: Products sections contain lists of Owner acceptable products. If product substitutions are proposed, they must be made based upon a comparison of equivalence to the product specified. Considerations may include but shall not be limited to functional, physical, aesthetic and/or interface aspects. The Owner shall be the sole judge of whether or not a submitted substitution is deemed to be "equivalent" to that specified.

C. Manufacturers Specification Reference: Where a specific material, devices equipment or systems are specified directly, the current manufacturers’ specification for the same becomes a part of these specifications, as if completely elaborated herein.
D. Equipment shall be new and the current model of a standard product of a manufacturer of record. A manufacturer of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied.

E. For each item of equipment offered, manufacturer shall maintain:
   1. A factory production line.
   2. A stock of replacement parts.
   3. Engineering drawings, specifications, operating manuals and maintenance manuals.
   4. Manufacturer shall have published and distributed descriptive literature and equipment specifications on each item of equipment offered.

F. Complete System: Auxiliary and incidental equipment necessary for the complete operation and protection of the systems specified herein shall be furnished and installed as if specified in full.

G. Similar Devices: Similar devices within a system shall be identical unless specific color variances are required by the Owner or Architect.

H. Safety: Unless otherwise specified, equipment shall be UL rated individually and listed as an assembly. Electronic equipment shall be of the dead front type, having no exposed live electrical connections, terminals or exposures to hands-on operating surfaces or other exposed surfaces during any power-on condition. Every live electrical connection, terminal or exposure shall be covered with durable, removable insulating material.

I. Rack Mounting: Rack-mounted electronic equipment shall be specifically designed or modified for standard 19-inch rack mounting unless otherwise noted.

J. Keying: Key panels identically where provided for similar usage within a system. Coordinate lock types with Owner.

K. Framing: Floor supported units shall be substantially framed and supported. All bolted connections shall be made with self-locking devices.

L. Aesthetics: Coordinate console or control panels so that their general appearance is similar. Provide locking panel covers on recessed, semi-recessed and surface mounted control panels not located in equipment rooms. Control panels shall be contained within or mounted to formed and welded aluminum or steel back-boxes. Operating panels shall be recessed within the back-box to a depth sufficient to permit a locking hinge panel cover to close completely without affecting any device within the enclosure.

M. No contractor proprietary equipment will be permitted without prior approval from the Owner.

N. Operational Voltage: Devices connected to the fuse or breaker protected electrical system and all auxiliary equipment necessary for the operation of the equipment associated with systems specified herein shall be designed to operate from 105 to 130 volt, 60 Hertz, alternating current service, with stable performance, fully in accordance with these specifications, and shall have integral fuse or circuit breaker protection.

O. Contractor-fabricated items shall be provided with fuses that indicate when they are blown or defective.

P. Protection devices shall be located to facilitate replacement, resetting or observation of status without demounting the associated unit and/or de-energizing adjacent equipment.

Q. Manufacturer's Recommendations: Components and devices shall be operated in accordance with recommendations of the manufacturer and shall contain sufficient permanent identification to facilitate replacement.
R. Testing Requirements:
1. Equipment, devices, and assemblies shall meet the local city requirements for listing and labeling, which includes UL listing and labeling for manufactured equipment.
2. UL Listing: For devices and assemblies with proper UL listing and labeling, stickers shall be accessible and visible to the Inspectors. Paperwork shall also be available during inspections and shall be provided to the Owner as part of the close out documentation.
3. Unlisted Devices and Assemblies: Devices and assemblies without prior listing from testing authorities accepted by the local city, shall be tested by an agency acceptable to the local city prior to inspection, to obtain a listing and label. Documentation on the testing and approval shall be provided to the Owner as part of the close out documentation.

2.2 MISCELLANEOUS PRODUCTS

A. Cabinets: Hoffman, Rittal or equal, assembled and wired with all components and as indicated on the drawings. Coordinate color, location, and trim with the Owner.

B. Cable Termination Devices: Screw-Type Barrier Blocks: Marathon/Kulka 601 or Kulka 601-3700 Series, TRW-Cinch, 140, 141 and 142 Series, Phoenix or Buchanan.

C. Relays: Control relays to be provided by the Contractor shall meet or exceed the following:
1. Provide U.L. listed single pole, double throw (SPDT) type, unless otherwise noted on the drawings, with silver tin oxide contacts.
2. They shall have a contact rating of 250 V AC/DC at 6A on normally open contacts and 2A on normally closed contacts.
3. Control relay bases shall be UL listed, DIN rail mounted style, and shall be compatible with the proposed control relay. They shall have screw terminals for all wiring leads accepting conductors up to size 14 AWG. Relay bases shall have provisions for accepting machine printed labels.
4. Control Relays: Provide relays and bases by Potter & Brumfield, Square D, or equal.

D. Wire and Cable Management: Provide Thomas and Betts Ty-Duct Series of Slotted Wiring Ducts, or equal by Marathon, or Eaton. Wiring duct shall be used within cabinets, enclosures, and terminal boxes for the distribution and management of cables within the enclosures. Provide compatible mounting hardware, end caps, labeling and appurtenances to form a complete wire management system. Comply with manufacturers recommended maximum fill schedules.

E. Theft Proof Screws
1. Provide Tamperproof security fasteners for the installation of security equipment, cabinets, enclosures and pull boxes in accessible locations. Provide Bryce Fastener PentaPlus series, TP3 style by Tamperproof Screw Company, or equal by Hudson Fastener.
2. Provide six (6) compatible screw drivers and transfer to the Owner prior to final acceptance testing.

F. Equipment Enclosure
1. Indoor Wall Mount Rack Enclosures
   a. Provide Atlas WMA Series, or Bud Cabinets Emperor Series, or equal, sectional wall cabinets, with door and mounting rails for standard 19” rack mount equipment.
   b. Cabinet shall be in three sections: solid door, center section, and rear section. Door and center section shall swing out, permitting service from the rear without disassembling equipment. Center section depth shall be 15”, minimum.
   c. Contractor shall size the height of the cabinet to house applicable equipment, terminals, wire and devices in a neat and workmanlike manner.
2. Indoor Enclosures: Refer to configurations within Specification Section 28 13 00 Electronic Access Control System

3. Outdoor Enclosures: Provide Hoffman DesignLine Type 3R or Type 4 Enclosure, or equivalent, with 10 Gage steel body and door, swing-out rack mount, and extension ring kits as required to house specified equipment. Provide tamper resistant key lock. Contractor shall size the cabinet to house applicable equipment, terminals, wire and devices in a neat and workmanlike manner.

2.3 TEST EQUIPMENT

A. The Contractor is responsible for providing test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system and retain ownership of the equipment. The Contractor shall furnish test equipment of an accuracy better than the parameters to be tested.

B. The test equipment list shall be furnished as a part of the submittal.

C. Readiness: Keep test equipment at hand and maintain in calibrated condition at the jobsite as required for routine and performance testing of this work.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform this work in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.

B. Aesthetics are an important consideration in this installation. Components shall be installed so as to have aesthetically pleasing results per Owner and Architect requirements. Actual locations of visible components shall be coordinated in advance with Owner and Architect.

C. The Contractor shall insure that installation personnel understand the requirements of this Specification.

3.2 COORDINATION

A. General

1. This Contract involves functioning systems. Coordination with the Owner is critical. Do not interrupt any functioning system without complying with the requirements of “Notification” section of this specification.

2. Coordinate the work with the Owner and all trades to assure that where this work interfaces to other trades, those interfaces are provided, complete and functional.

3. Meet with the Owner and each trade. Identify devices needed to complete functional operation of this work which are being provided by Owner, General Contractor or another trade, and assure that the work being provided by others will be acceptable.

4. Make sure work by others is scheduled in order that this work can be installed in a timely fashion.

5. Verify dimensions, and work by others which may be necessary to facilitate the work and coordinate with other trades. Assure that related work by others is coordinated with this work.

6. Verify field conditions. Regularly examine construction and the work of others which may affect the work to ensure proper conditions are provided for the equipment and devices before their manufacture, fabrication or installation. Be responsible for the proper fitting of the systems, equipment, materials, and devices provided as part of this work.
B. Required Resources: Become familiar with the available access and space for equipment and any potential interference requiring coordination. Coordinate with the Owner to assure that adequate electrical and HVAC, services are available. Provide the physical space for equipment, and ample access room for installation and maintenance of equipment.

C. Positioning Members: Provide additional support or positioning members as required for the proper installation and operation of equipment, materials and devices provided as part of this work as approved by the Owner without additional expense.

D. Interface Devices: Provide items necessary to complete this work in conformance with the Contract Documents or the satisfaction of the Owner without any additional expense.

E. Equipment shall be mounted with sufficient clearance to meet applicable codes and facilitate observation and testing. Securely hang and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.

F. Installation shall comply with "Codes and Standards" section of this specification. Where more than one code or regulation is applicable, the more stringent shall apply.

G. Where new equipment is replacing old equipment, Contractor is responsible for removing the old equipment and doing repair work necessary to meet standards determined by Owner.

H. Install fire stopping for penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to Owner.

I. Project Documentation: Review project documentation. If the Contractor perceives conflict or ambiguity in the contract documents, he shall seek interpretation from the Owner. Failure to do so may result in remedial work.

J. Project Schedule: Immediately obtain and follow the project schedule established by the Owner. Failure to maintain the schedule may result in a requirement by the Owner to expend extra effort until the project schedule has been achieved.

K. Schedule Changes: Time is of the essence of this agreement. In the event that it becomes necessary for the Contractor to expend "extra effort" to complete the work according to schedule changes not covered above, the Contractor agrees to cooperate with the Owner in good faith to complete the work according to schedule requirements.

L. Supervision: Maintain a competent supervisor and supporting technical personnel acceptable to the Owner during the entire installation. A change of supervisor during the project shall not be acceptable without prior written approval from the Owner.

M. Work and Manpower Rules: Comply with applicable jobsite work and manpower regulations.

N. Found Conflicts: Continuously make known to the Owner, conflicts discovered which may affect the orderly completion or the specified performance of this work. Cooperate with the Owner and other trades to accommodate such changes as may be necessary to resolve found conflicts.

O. Coordination Difficulties: Promptly notify the Owner in writing of any difficulties which may prevent proper coordination or timely completion of this work. Failure to do so shall constitute acceptance of construction as suitable, to receive this work, except for defects that may develop in the work of others after its execution.

P. Environmental: Verify the intended location(s) for equipment is suitable for the equipment. If conditions such as temperature, humidity, dust level or the like require modification, make it known to the Owner immediately upon award of the contract. If equipment requires strict
environmental conditions (dust limitations, etc.), notify the Owner immediately upon award of the Contract. Failure to notify the Owner of such conditions shall constitute acceptance of the conditions and any later required modifications to the equipment or the environment shall be at the sole cost of the Contractor.

Q. Extra Effort: The Owner retains the right to require the Contractor to expend whatever extra effort as may be required, in event the Contractor fails to perform satisfactorily at any milestone date, unless such delay is approved in writing by the Owner, or it can be proved by the Contractor that such delay was caused by other contractors, or Owner's intransigence relating to Owner requested changes in the scope of work. Any costs pursuant to such extra effort will be borne solely by the Contractor. If Project Schedule delays are approved, provide the Owner with monthly revisions of the Project Schedule reflecting actual performance vs. the schedule.

3.3 SEISMIC PROTECTION

A. General
   1. Seismic protection criteria: Electrical and mechanical machinery installations in any Seismic Risk Zone of the Uniform Building Code Seismic Risk Map shall be protected from earthquakes.
   2. Protection criteria for these zones shall be a Horizontal Force Factor not less than required by code or agency, considered passing through the machinery center of gravity in any horizontal direction.
   3. Unless vibration isolation is required to protect machinery against unacceptable structure transmitted noise and/or vibration, machinery shall be protected from earthquakes by rigid structurally sound attachment to the load supporting structure. The number shall be determined by calculations performed by a registered California professional engineer, as verified by the seismic restraint vendor.
   4. Use protected spring isolators, or separate seismic restraints, to protect vibration isolation machinery.
   5. Seismic snubbers and protected spring isolators shall be seismic protection-rated along three principal axes, proven by independent laboratory testing or analysis, by an independent, licensed structural engineer.

B. The Contractor shall be responsible for the design of his method for seismic restraint systems, and shall supply all seismic calculations and details to the Owner for review. The Contractor shall supply to the Owner details of the forces exerted by his restraints, anchorages, and other points of attachment.

C. Electrical and mechanical equipment shall be installed in accordance with the following guidelines:
   1. SMACNA Publication: Guidelines for Seismic Restraints of Mechanical Systems
   2. California Code of Regulations (CCR), Title 24, Division 22
   3. NUSIG – National Uniform Seismic Installation Guidelines

D. Contractor shall submit shop drawings for the mounting of equipment, fixtures, cabinets, consoles, conduit, and cable support racks (where required). These drawings shall be prepared, stamped, and signed by a Registered California Structural Engineer.

3.4 WORKMANSHIP

A. The installation shall be performed in a professional and workmanlike manner.

B. On a daily basis, clean up and deposit in appropriate containers debris from work performed under the appropriate Specification sections. Stack and organize parts, tools and equipment when not being used.
C. Preparation, handling, and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.

D. Work shall conform to the National Electrical Contractors Association "Standard of Installation" for general installation practice.

E. At the conclusion of the installation, work areas, including panel boxes, shall be vacuumed and cleaned to remove debris and grease.

3.5 EQUIPMENT ENCLOSURES, RACK, AND CONSOLE INSTALLATION

A. Construction: Coordinate access openings and wire paths through the cabinets for all desk mounted devices.

B. Compliance: Comply with powering, conduit entry and grounding practices as described herein and as required by code.

C. Coordination of Access: Coordinate the installation of access covers, hinged panels or pull-out drawers to ensure complete access to terminals and interior components. Access shall be designed such that demounting or de-energizing of equipment is not required to gain access to any equipment.

D. Enclosures: Fasten removable covers containing any wired component with a continuous hinge along one side with associated wiring secured and dressed to provide an adequate service loop. Appropriate stop locks shall be provided to hold all hinged panels and drawers in a serviceable position.

E. Service Loop: Provide a wiring service loop allowing relocation of termination to any point within the enclosure.

3.6 CUTTING, PAINTING AND PATCHING

A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner for each instance. Provide means to identify rebar in slabs prior to drilling.

B. Walls and other architectural features that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors, and finishes to the satisfaction of Owner, and at no additional cost to Owner.

3.7 GROUNDING PROCEDURES

A. Provide grounding of systems and equipment in accordance with manufacturer's recommendations, local electrical codes, and industry standards.

B. Signal Ground: Signal ground shall be derived from the one main electrical panel which serves all equipment herein.

C. Grounding procedures for wire, equipment and devices shall be in strict accordance with manufacturers' recommendations and standard installation practices.

D. Equipment enclosures of an assembly shall be grounded to the single grounding terminal strip of each assembly.
E. Multiple Powered System Isolation: Where powered devices of the same system exist in two or more locations and a different signal ground exists in each location, the system’s communication signal shall be isolated from signal ground at both source and destination ends via modem, fiber optics or other equivalent method.

F. Contractor shall eliminate or correct potential ground-loop problems in a manner approved by the Engineer.

G. Shielding: Shielded cables of this section shall be grounded exclusively to Signal Ground. No shields shall be permitted to carry live currents of any kind. Shields shall be tied to Signal Ground at the signal source end only, unless otherwise noted or required by the manufacturer.

3.8 CONDUIT AND WIRE INSTALLATION PRACTICES

A. Conduit
1. Conduit shall be 1-inch minimum unless noted otherwise on the drawings
2. Wires shall be installed in conduit or in another Owner approved raceway for power and exposed wiring, in areas where mechanical or environmental conditions may damage conductors, and where otherwise specified herein or required by code.
3. Conduit or raceway that is not hidden must have its location and appearance be specifically approved by Owner. If approved, exposed conduit or raceway shall be run in such a fashion as to make it as inconspicuous as possible. Runs should follow existing building lines and should be square wherever possible.
4. Verify conduit has been installed, de-burred and properly joined, routed, and terminated prior to pulling of cables.
5. Apply a chemically inert conduit lubricant to wire and cable prior to pulling. Do not subject wire and cable to tension greater than recommended by the manufacturer
6. Secure wire and cable runs vertically in conduit for continuous distances greater than thirty (30) feet at the vertical run terminations. Non-coaxial cables shall be secured by screw-flange nylon cable ties or similar devices. Symmetrical clamping devices with split, circular, or other wire conforming, non-metallic bushings shall be provided for other cables.

B. Wiring Without Conduit
1. Wiring may be run in concealed spaces without conduit, in electrical trays, and where otherwise shown on drawings, provided conductors are reasonably protected from mechanical and environmental damage.
2. Any security wiring that is visually exposed must be installed in conduit
3. Conductors run without conduit shall be approved, UL Listed, rated and labeled for Plenum use.
4. Secure wire and cable with approved supports in accordance with the referenced standards and the Authority Having Jurisdiction.
5. Provide cable supports at a minimum of 4-foot intervals.
6. Equipment and devices shall be installed on approved electrical back-boxes. Do not install equipment and devices directly on walls, ceilings, or structural components without back-boxes.
7. Secure cables to cabinets, junction boxes, pull boxes and outlet boxes with approved cable clamps.
8. Independently support cables. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical piping, or mechanical ducts).
9. Support cable independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
10. Support cable using cable trays, D-brackets, support straps, support wires or other approved cable supports.
11. Fasten cable supports to building structure and surfaces.
12. In shared electrical trays, open ducts, and other cable runs without conduit, separate and strap Access Control cable so that it is clearly distinguishable from all other cables.

13. Clearly mark security system cables at minimum intervals of every 10-feet. Marking shall be with a permanent, printed label, color-coded tag, or other distinguishing marking. Felt tip pen marking on the cable is not acceptable.

C. New Wiring

1. After installation, and before termination, wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors or shields. In addition, wiring between buildings or underground and all coax cables shall have insulation tested with a megohmeter and a reading of greater than 20 megohms shall be required to successfully complete the test.

2. Run wires continuously from termination to termination without splices. Splices at junction box locations may be allowed at the discretion of the Owner. Recommendations for splices at these points shall be established with Owner. Contractor shall obtain approval from the Owner before proceeding with splices.

3. If splices are required and approved by Owner, the wire shall be joined with solder, then taped or otherwise protected in an approved manner so as to provide mechanical and electrical integrity. Wire nuts and/or electrical tape connections shall not be acceptable. Final connections shall be made at terminal boards with full tagging, labeling and documentation.

4. Water-resistant protection shall be continuous throughout the cable in parking areas, surface conduit, poles, in-slab pull-boxes, in-slab conduit, and underground conduit and pull-boxes, and in any areas subject to moisture and/or water infiltration:
   a. Splices/Junctions: Provide water-proof protection of splices and junctions, in surface conduit and boxes, in-slab conduit and pull-boxes, underground conduit, and underground pull-boxes, to prevent the entry of moisture or water into cables, splices, or connections.
   b. Cable Entries: Provide water-blocking sealants at all conduit entries into pull-boxes, junction boxes, back-boxes, cabinets, etc., to prevent the entry of moisture or water into the conduit and cable system.

D. Boxes: Provide a box loop for wire and cable routed through pull boxes or controller panels. Cable loops and bends shall not be at a radius less than that recommended by the manufacturer. Coordinate pull box size with the Division 26 Contractor as necessary to accommodate this requirement.

E. Wire Lacing and Dressing: Dress, lace, tie or harness wire and cable vertically, horizontally and at right angles to the enclosure surfaces to prevent mechanical stress on electrical connections as required herein and in accordance with accepted professional practice. No wire or cable shall be supported by a connection point.

F. Non-Coaxial Connections: Make non-coaxial connections and approved splices within terminal cabinets (except microphone or line level) to screw-type barrier blocks with insulated crimp-type spade lugs. Size all lugs properly to assure high electrical integrity. Connect only one (1) wire per spade lug and not more than two (2) lugs per screw terminal.

G. Non-Coaxial splicing at device locations to equipment with wire leads shall be made with pre-approved wire Dolphin Connectors.

H. Shielded Cables: Shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, terminal cabinets, or equipment enclosures. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

I. Coaxial Splices: Coaxial splices, if required and approved, shall be on plate mounted dual-barrel type insulated BNC connectors, secured in such a manner that no stress is placed upon the connector.
J. Unacceptable Conditions: Correct any unacceptable wiring conditions immediately upon discovery, and upon receiving notice to correct.

3.9 DATABASE PREPARATION, CHECKING AND ACTIVATION

A. Contractor to provide forms with completed nomenclature for each identified device no less than 30 days prior to programming.

B. Programming
   1. The Contractor shall be responsible for the full programming of devices and equipment installed in this project. The database shall consist of hardware and function-related information, i.e., system configuration, doors, alarm points, software parameters for system management, graphical maps, intercom interfaces, alarm information – access levels, automatic opening and locking schedules. A printout of the final database shall be provided to the Owner for review and approval prior to system activation.
   2. Programming rights shall be provided the Owner. Contractor shall coordinate with the Owner prior to the completion of installation to set a schedule for access to programming resources.

C. System activation shall be the responsibility of Contractor.

3.10 SOFTWARE UPGRADES

A. If more recent versions of the operating system or application software are made available to or requested by the Owner prior to system acceptance, these updated versions shall be installed and verified by Contractor.

B. Before installing upgrade software, Contractor shall ensure that existing database information is properly "backed-up" prior to any installation action.

3.11 START-UP RESPONSIBILITY

A. Contractor shall initiate System Operation. Competent start-up personnel shall be provided by Contractor on each consecutive working day until the System is functional and ready to start the acceptance test phase. If in Owner's judgment Contractor is not demonstrating progress in solving any technical problems, Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to Owner, until resolution of those defined problems. Where appropriate, Contractor will bring the System on-line in its basic state (i.e., alarm reporting, facility code access control, etc.).

B. Properly ground each piece of electronic equipment prior to applying power.

C. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.

D. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational.

3.12 PRELIMINARY, INSPECTION, ACCEPTANCE TESTING, AND COMMISSIONING

A. Provide Preliminary Testing, Inspection, Acceptance Testing, Burn-In and Commissioning Performance services for systems and equipment in accordance with Testing and Commissioning, Section 28 08 00.
3.13 FINAL PROCEDURES

A. Portable Equipment: Furnish portable equipment specified herein to the Owner, along with complete documentation for the materials furnished. Portable equipment shall be presented in the original manufacturer's packing, complete with manufacturer's instructions, manuals and documents. Testing of portable equipment shall have been previously conducted by the Contractor.

B. Post Acceptance Work: Check, inspect and adjust systems, equipment, devices, and components specified, programming updates, at the Owner's convenience, approximately sixty (60) days after Acceptance of the Installation.

3.14 NOTICE OF COMPLETION

A. When the performance and acceptance requirements described above, including the Final Acceptance Test, have been satisfactorily completed, the Owner shall issue a Letter of Completion to Contractor indicating the date of such completion. The Notice of Completion shall be recorded by Contractor upon receipt of the Owner completion letter. This date of record shall be the start of the warranty period.

END OF SECTION
SECTION 28 05 53
IDENTIFICATION FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section.

1.2 DESCRIPTION
A. This specification section covers the furnishing and installation of nameplates, labels, wire markers, and other identification components for security systems.
B. Contractor shall furnish and install identification devices as specified on cables, cabinets, racks, and equipment.

1.3 PRECEDENCE
A. Obtain, read, and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

1.4 GENERAL CONDITIONS
A. In accordance with Section 28 05 00, Security System General Requirements

1.5 RELATED WORK
A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section.
B. In accordance with Section 28 05 00, Security System General Requirements
C. In accordance with Section 28 08 00, Security System Testing, and Commissioning
D. In accordance with Section 09 90 00, Paints and Coatings

1.6 SHOP DRAWINGS & EQUIPMENT SUBMITTALS
A. In accordance with Section 28 05 00, Security System General Requirements
B. Product Data:
   1. Submit manufacturer’s catalog literature for each product required.
   2. Submit identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
1.7 WARRANTY

A. In accordance with Section 28 05 00, Security System General Requirements

1.8 REQUIREMENTS FOR IDENTIFICATION AND TAGGING

A. Cables, wires, wiring forms, terminal blocks, and terminals shall be identified by labels, tags or other permanent markings. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. The wire marking format contained in the shop drawings shall be utilized for conductors installed under this Specification. Cables and wires shall be identified, utilizing heat-shrink, machine-printed, polyolefin wire markers (Hand written tags or marker on wiring is not acceptable.)

B. Should a situation arise where the wire tagging format as shown on the shop drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all System wiring.

C. Terminal points shall be appropriately identified and labeled as shown on shop drawings.

D. Nameplates – General:
   1. Provide laminated, engraved plastic nameplates with 3/8-inch-high letters for all panels, enclosures and cabinets. Attach nameplates to gear with sheet metal screws where applicable. Adhesive mounted nameplates are generally not acceptable.
   2. Include nameplate schedule on shop drawing submittals.
   3. Install nameplates behind panel door in public areas and on panel face in equipment rooms.
   4. Nameplate Color Schedule:
      a. Fed from Normal Building Power: Black letter on White label
      b. Fed from Emergency/Generator Power: White letters on Red label

E. Panels shall be provided with permanently attached engraved lamacoid labels, as described in Item E, with identifying names and functions. Labels shall be consistent in form, color, and typeface throughout the system and must contain the name of the system or subsystem as part of the label textual information. Hand written tags or marker type identification is not acceptable.

F. Equipment/Equipment Racks: Provide an engraved lamacoid label, as described in Item E, on the front of equipment including its designation as assigned and referenced consistently throughout this project.

G. Enclosures and Cabinets:
   1. Provide an engraved lamacoid label, as described in Item E, on the front of wall mounted control enclosures and equipment racks including its designation as assigned and referenced consistently throughout this project.
   2. Within each equipment enclosure and/or terminal cabinet, the contractor shall place a Single Line drawing of the system(s) and the respective Equipment/Terminal Cabinet Wiring Diagram in a clear plastic 8” x 11” sleeve permanently attached to the inside cover of the terminal cabinet. Drawings shall include cable and equipment label designations to match the labeling within the cabinet.
   3. In each equipment enclosure, the contractor shall place an as-built drawing depicting device locations served by the equipment within the enclosure, with identification that is identical to the wiring tags and with the software description of each point.
   4. In each equipment enclosure, the contractor shall place a copy of the EACS System Excel Spreadsheet or equal document depicting device names, MAC addresses and IP addresses as indicated in the EACS system.
H. Door Openings: For all doors controlled by the EACS system, provide a P-touch label with the door name (as named in the EACS program) on the top of the door edge on the hinge side. P-touch label shall be black lettering on white 1/4” tape. Coordinate with Owner for exact location.

I. EACS Panel Relays: All relays on EACS panels shall be labeled with P-touch label 1/4” tape, black lettering on a white label, identifying the LA LGBT door number associated with the relay. Architectural door numbers are not acceptable for these labels.

J. Panic Bar: All panic bars shall be labeled on the inside of the hardware with P-touch label 1/4” tape, black lettering on a white label, identifying the location of the power supply feeding the door including room name and room number.

K. Wire and Cable: Identify wire and cable clearly with permanent labels wrapped around the full circumference within one-inch of each connection. Correlate the number designated on the associated Shop or Field Drawings. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Product Acceptability: The Products section contains lists of acceptable products. If product substitutions are proposed, they must be made based upon a comparison of equivalence to the product specified. Considerations may include but shall not be limited to functional, physical, aesthetic and/or interface aspects. The Owner shall be the sole judge of whether or not a submitted substitution is deemed to be “equivalent” to that specified. Contractor may not use contractor proprietary interface modules for connections between field devices and controller.

B. Labeling:
   1. Provide intelligible permanent engraved identification function on or adjacent to panel assemblies, power supplies, and cabinets.
   2. Provide intelligible permanent label-maker labels for relays, controls, fuses and/or circuit breakers, patching jacks, connectors, receptacles, terminal blocks, indicators, switches, monitors, and servers.
   3. Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.

C. Engraving, labels, decals or other identification on any device, equipment or miscellaneous component shall be coordinated with the associated Field and Shop and Equipment Wiring Drawings.

D. No proprietary identification on assemblies will be permitted other than the original manufacturer’s labels and identification.

2.2 MISCELLANEOUS PRODUCTS

A. Wire and Cable Labels: Provide Brady Type B-321, dot matrix and thermal transfer printable sleeves, with permanent ink ribbon printing, or Thomas and Betts EZ-W/YHS, or equal. Sleeves shall be constructed of heat shrinkable, high density polyolefin film coated and shall have an ink-receptive top-coating. Labels shall be pre-printed to match the designations shown on the shop drawings, fitted to cables in the field, and heat shrunk to secure their position. Labels should be placed such that they are easily accessed and readable after the device or panel is fully dressed.
B. Equipment Labeling: Unless otherwise noted herein, provide Laminated three-layer plastic with engraved black letters on white background color. Minimum thickness shall be 1/8”. Letter size shall be 3/8”-1/2” for equipment and controls.

C. Cabinet/Enclosure Labeling: Unless otherwise noted herein, provide Laminated three-layer plastic with engraved black letters on white background color. Minimum thickness shall be 1/8”. Letter size shall be 1/2” minimum.

PART 3 - EXECUTION

3.1 GENERAL

A. In accordance with Section 28 05 00, Security System General Requirements.

3.2 LABEL AND NAMEPLATE INSTALLATION PRACTICES

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

C. Install identifying devices after completion of painting and finishes.

D. Nameplate Installation:
   1. Install nameplate parallel to equipment lines.
   2. Install nameplate for each control equipment enclosure with corrosive-resistant mechanical fasteners.
   3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
   4. Secure nameplate to equipment front using screws.

E. Wire Marker Installation:
   1. Install wire marker for each conductor at each connection.
   2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
   3. Install labels at data outlets identifying patch panel and port.

3.3 PRELIMINARY INSPECTION AND TESTING

A. Provide preliminary inspection and testing services for systems and equipment in accordance with Testing and Commissioning, Section 28 08 00.

3.4 FINAL PROCEDURES

A. Perform final procedures in accordance with section 28 05 00, Security System General Requirements.

END OF SECTION
SECTION 28 07 00
SECURITY SYSTEM INTEGRATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Description: This specification section covers the provision of mechanisms which will support the exchange and recognition of information and commands between various Security systems at MiraCosta College - Community Learning Center.

B. Contractor shall coordinate with providers of systems listed herein to provide equipment, software, and configuration that will support the required functionality and performance.

1.2 QUALIFICATIONS

A. Provide the work in accordance with Section 28 05 00, Security System General Requirements.

1.3 GENERAL CONDITIONS

A. Provide the work in accordance with Section 28 05 00, Security System General Requirements.

1.4 RELATED WORK

A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section.

B. Provide the work in accordance with Section 28 05 00, Security System General Requirements.

1.5 SHOP DRAWINGS & EQUIPMENT SUBMITTAL

A. Provide the work in accordance with Section 28 05 00, Security System General Requirements.

B. In addition to the requirements of Section 28 05 00, provide the following information for each system to be integrated:
   1. Describe the integration architecture between systems. Provide a single-line diagram showing relationships between integrated components.
   2. If a central integration processing component or user-interface (server, application) is proposed, describe the hardware and application software proposed.
   3. A detailed description of how the interface will be accomplished between each system, including proposed connectivity, hardware, software, language, protocols, procedures, and standards.
   4. Proposed Software Development Kit (SDK) and Version, where an SDK already exists from the component manufacturer. Provide development and capabilities information on the SDK and its proposed use on this project.
   5. Development specification for custom software development, where the interface must be created specifically for the project.
6. A detailed list, or matrix, of information, commands, and other elements of the interface, delineating exactly what functions will be supported between each system, and how they will work.

1.6 OPERATIONS AND MAINTENANCE MANUALS
A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

1.7 WARRANTY
A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

1.8 SERVICE AND MAINTENANCE
A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

1.9 TRAINING
A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

1.10 EQUIPMENT COMPATIBILITY REQUIREMENTS
A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

1.11 OWNER’S RIGHT TO USE EQUIPMENT
A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

1.12 TECHNICAL REQUIREMENTS, ACCESS CONTROL SYSTEM INTEGRATION
A. General
1. The Contractor shall be responsible for providing hardware and software interfaces to achieve the specified system performance described herein and, by reference, realize absolute and seamless compatibility with the related component systems.
2. The Contractor shall ensure system additions and modifications provided under this scope of work have no negative effect on the individual components and systems, and their core functionality, and no permanent effect beyond that specified or implied by the scope of work.

B. Purpose
1. Integration is the process of designing, deploying, and configuring independently operating systems with the ability to request, receive, extract, process, and act upon information from other systems.
2. Successful system integration must address three fundamental issues:
a. Functionality: What information is needed, how it is to be requested and processed, and what functions or activities need to occur upon receipt of the information.
b. Connectivity: How systems will be connected together to support the communication of information and commands. (Special interfaces, wiring, networks, databases.)
c. Communication: How information will be communicated between systems. (Instruction sets, language, protocols, formats, priority.)

C. Environment
1. Integration components shall generally comprise special elements of independent subsystems, and shall be located within, or in close proximity to, the processing components of each independent subsystem. Where subsystems require special hardware or communications interfaces to support integration, the special hardware should be located near the independent subsystem processing components or network appliance, based on the manufacturers’ recommendation. See the drawings for details on mounting locations.
2. Infrastructure and Connectivity
   a. Devices/Appliances: Appliances and devices shall be connected to their respective systems via the applicable communications network.
   b. System LAN/WAN Connectivity: System Servers and microprocessor-based Control Panels, shall reside on the Local Area Network (LAN) or Wide Area Network (WAN) tier designated for integrated components.

D. Attributes
1. The attributes of the integrated environment are primarily defined by the subsystems that are to be integrated.
2. Integrated systems comprise the processors, software, electrical control panels, data gathering panels, special data interfaces, and converters required to allow systems to communicate with each other, process information, and allow users to program and perform operations.
3. The following systems will be a part of the integrated environment:
   a. Electronic Access Control System (EACS)
   b. Video Surveillance System (VSS) by others

E. Functions
1. The system shall provide the following automated processing rules, at a minimum:
   a. The object of “Access Control system integration” is to automatically configure the system to display, record, and report appropriate system activity to various elements of the system. Automatic configuration can free operators from difficult control tasks, give the operator more time to respond to events, reduce operator error, and ensure critical system tasks occur consistently.
   b. Access Control system elements (EACS) shall be electronically integrated in such a way as to enable video, video detection, database records and/or event-initiated instructions to be communicated between system components, to initiate recording, display, communication, and control activities.
   c. Event-Initiated Interface, General:
      1) The system shall support the capability to send and receive alarm and control messages between the EACS and VSS systems via a LAN communications link, using API, XML, or other industry-standard communication languages and formats, and shall act upon those messages received.
      2) Where integration may require the implementation of RS-232 interfaces, Contractor shall propose such integration to the Owner for approval, before proceeding with the work.
      3) All software routines required to accomplish the required data-interface with external equipment and controls will be fully developed, installed, tested, and supported by the Contractor.
4) The manufacturer of each applicable system will also support the data-interface, and will be engaged by the Contractor to provide on-site technical assistance where required to prepare, repair, configure, and test the system to operational condition.

5) Communication of event information between systems shall take place automatically and immediately, when the event is sensed by the system.

6) “Hard-wired” interfaces used to support interactive video surveillance cameras, intelligent video, threat-based control, and other event-initiated functions shall not be acceptable, except as otherwise noted herein or shown on the design drawings.

d. Intercom / Emergency Phone Integration

1) Upon activation of the push button the system shall record an event in the EACS for date and time.
   a) Activate a video camera where required by the Owner.
   b) Start the process for voice communication with respondent.

e. VSS Event-Initiated Control

1) Upon receiving event/alarm information from the EACS, the VSS system shall transmit camera pre-positioning commands to applicable pan/tilt/zoom cameras, and shall cause the system to process, display, and record applicable cameras.

2) The system shall automatically position and focus one or more cameras, or sequence of cameras, on nearby alarm locations. Coordinate with the Owner on initial and alarm preset camera views and programming.

3) Configure systems to automatically send camera positioning and display commands from the EACS systems to the VSS Virtual Switching and Recording Software, based upon EACS event data. The system shall:
   a) Automatically select, position, and focus one or more cameras on areas of concern;
   b) Automatically re-configure recording for the selected cameras, to record them in an enhanced format, at the highest available resolution, frame rate, and quality (all other cameras remain at their pre-programmed format);
   c) Automatically display the selected cameras on one or more monitors, client workstations, and other display devices, in a pre-selected configuration (single or multi-camera views).

f. This interface shall be implemented using the integration scheme described herein.

g. Recorder/Camera Control: Configure the EACS to allow control of the VSS system. At a minimum, the EACS should support the following VSS system functionality:

1) Link alarms or events to a camera, with programmable pre-and post-alarm recording sequences.
2) Fast-forward, rewind, pause, and print, pre-recorded video.
3) View recorded video “tagged” or associated with EACS alarms or events.
4) Access a Windows-style Tree view of connected cameras.
5) Select camera icon from map to view live video.
6) View a single live video feed in full-screen.
7) View up to 4 simultaneous camera views in quad-view format.
8) Receive and display digital video recorder generated alarms such as video loss and motion detection.
9) Trigger conditional commands on digital video recorder generated alarms.
10) Send video matrix commands via selected camera icon.
11) View recorded video from History Activity report, and/or Alarm Monitor window.
12) Identify alarms and events that have associated video available for review.
13) Full video playback available at all EACS clients.
14) View associated video from the Alarm Monitor window, based on reported alarms.
15) Provide both manual and preset pan-tilt-zoom control.
PART 2 - PRODUCTS

2.1 NOT USED. REFER TO INDIVIDUAL EQUIPMENT SECTIONS FOR SPECIFIED SYSTEMS.

PART 3 - EXECUTION

3.1 GENERAL
   A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

3.2 COORDINATION
   A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

3.3 WORKMANSHIP
   A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

3.4 EQUIPMENT, RACK, AND CONSOLE INSTALLATION
   A. Provide equipment, rack, and console installation in accordance with Section 28 05 00, Security Systems General Requirements.

3.5 GROUNDING PROCEDURES
   A. Provide grounding of all systems and equipment in accordance with Section 28 05 00, Security Systems General Requirements.

3.6 CONDUIT AND WIRE INSTALLATION PRACTICES
   A. Provide conduit, wire, and cable installation in accordance with Section 28 05 00, Security Systems General Requirements.

3.7 IDENTIFICATION AND TAGGING
   A. Provide identification of wire, panels, and devices in accordance with Section 28 05 00, Security Systems General Requirements.

3.8 DATABASE PREPARATION, CHECKING, AND ACTIVATION
   A. Provide database preparation, checking and activation for systems and equipment in accordance with Security Systems General Requirements, Section 28 05 00.
   B. Contractor shall coordinate with the Owner to determine the required pre-programmed surveillance, rule-setting, and event-initiated configurations.
3.9 START-UP RESPONSIBILITY
   A. Provide start-up services for systems and equipment in accordance with Security Systems General Requirements, Section 28 05 00.

3.10 PRELIMINARY INSPECTION AND TESTING
   A. Provide preliminary inspection and testing services for systems and equipment in accordance with Testing and Commissioning, Section 28 08 00.

3.11 SYSTEM PERFORMANCE TESTING AND ADJUSTING PROCEDURES
   A. Provide performance testing, burn-in, and adjusting of systems and equipment in accordance with Section 28 08 00, Testing and Commissioning.
   B. Performance Testing
      1. Demonstrate the operation of each camera that is associated with EACS monitoring or card reader points.
      2. Demonstrate automated call-up, pre-positioning and graphical map control of each camera, from the EACS GUI screens.

3.12 BURN-IN PERFORMANCE PERIOD
   A. Provide a burn-in performance period to demonstrate the stability of the system, in accordance with Testing and Commissioning, Section 28 08 00.

3.13 COMMISSIONING AND VALIDATION
   A. Provide commissioning and validation services to prove and improve the effectiveness of the system, in accordance with Testing and Commissioning, Section 28 08 00.

3.14 FINAL PROCEDURES
   A. Perform final procedures in accordance with Section 28 05 00, Security Systems General Requirements.

END OF SECTION
SECTION 28 08 00
SECURITY TESTING AND COMMISSIONING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. General Description: This specification section covers the provision of preliminary testing, acceptance testing, burn-in performance testing, and the commissioning of various access control systems at the MiraCosta College - Community Learning Center.

B. Provide Testing to assure that electrical equipment and wiring is operational, within industry and manufacturers tolerances and is installed in accordance with other sections of these specifications.

C. Conduct tests in the presence of the Owner and the Owner's agents for the purpose of demonstrating the equipment or systems' compliance with specifications. Demonstrate electrical and mechanical tests to the Owner and the Owner's agents that the entire installation is functioning properly and that circuits, including power, control, instrumentation, relaying, integration, and communication, will function properly and as specified.

D. Furnish, install and maintain tools, instruments, material, test equipment, test connections and power. Furnish personnel including supervision and "stand-by" labor required for the testing, setting, and adjusting of electrical facilities and component parts including putting the above into operation.

E. Make tests with proper regard for the protection of equipment and personnel.

F. Protect equipment from subsequent testing of other equipment and systems after equipment has been tested, checked for operation, and accepted by the Owner.

G. Record test values of equipment, giving both "as-found" and "as-left" for existing conditions.

H. The witnessing of any test by the Owner does not relieve the Contractor of warranties for material, equipment, and workmanship, as specified in the General Conditions.

I. Check circuits for conformance with the wiring diagrams furnished by manufacturers.

1.2 RELATED SECTIONS AND REFERENCES

A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section.

B. In accordance with Section 28 05 00, Security System General Requirements

C. In accordance with Section 28 05 53, Identification for Electronic Safety and Security

D. In accordance with Section 28 07 00, Security System Integration

E. In accordance with Section 28 08 00, Security System Testing and Commissioning

F. Inspections and tests shall be performed in accordance with applicable codes and standards including the most current versions of NEC, ANSI, IEEE, NFPA, NEMA and OSHA.

1.3 SUBMITTALS

A. In addition to the requirements of Section 28 05 00, four (4) bound copies of the certified test reports shall be submitted to the Owner within seven (7) days after the completion of the work. The final report shall be signed and include the following information:
   1. Summary of the project.
   2. Description of the equipment tested.
   3. Visual inspection report
   4. Description of the tests
   5. Pre-Acceptance and Final Acceptance Test results
   6. Conclusions and recommendations
   7. Appendix including appropriate test forms
   8. Identification of the test equipment used

1.4 WARRANTY

A. Provide the work in accordance with Section 28 05 00, Security Systems General Requirements.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Furnish labor, instruments, products, temporary power, and sufficient materials required for testing at each test.

B. Correct deficiencies found as a result of tests and make replacements or repairs to tested products that are damaged as the result of the tests. This included Burn In Performance report reviews

C. Schedule tests at a time convenient to witnesses thereto or persons affected by the tests.

D. Provide fourteen (14) day written notification to the Owner for test procedures prior to the test.

E. Make records of all tests in a neat and legible form. Identify the equipment or system tested and the test data.

F. Check control, instrumentation, and power cables and conductors for proper connections, workmanship, and identification.

G. Test disconnect switches through an open and closed cycle for proper operation, alignment, and contact.

H. Additional tests required shall be as outlined under the various Sections of Division 26 and 28.

I. Submit to the Owner certified reports on all tests indicating full compliance with test requirements.
3.2 COORDINATION

A. Provide the work in accordance with Section 28 05 00, Security System General Requirements.

3.3 WORKMANSHIP

A. Provide the work in accordance with Section 28 05 00, Security System General Requirements.

3.4 PRELIMINARY INSPECTION & TESTING

A. Coordination: Coordinate testing of components of the system in cooperation with other trades.

B. Verification: Prior to performing Preliminary Testing, inspection, and/or final testing procedures, Contractor shall insure the following:
1. Safe and proper operation of all components, devices or equipment, and the absence of extraneous or interfering signals
2. Proper grounding of devices and equipment
3. Integrity of signal and electrical system ground connections
4. Proper powering of devices and equipment
5. Integrity of all insulation, shield terminations and connections
6. Integrity of soldered connections and absence of solder splatter, solder bridges, debris of any kind
7. Proper dressing of wire and cable with labels matching as-build documents
8. "Wire-checking" of all circuitry, including phase and continuity
9. Preliminary targeting and setup of video camera assemblies
10. Mechanical integrity of all support and positioning provisions, i.e.: as provided for video cameras, monitors, and any other equipment
11. Sequencing: If applicable, determine and record the sequence of energizing systems to minimize the risk of damage from improper startup
12. Proper operation of devices and systems in accordance with specified performance requirements
13. System is programmed for alarm reporting of each device and associated with the graphical maps
14. Verify system programming is defined.
15. Verify with Owner the provided designations for all devices.

C. Perform a Preliminary Inspection and Test to determine the operating status of components and systems prior to Final Acceptance Testing.
1. Testing Security Equipment, Enclosures, and Cabinets
   a. Test each equipment enclosure for tamper alarm
   b. Test each power supply battery for power loss alarm reporting
   c. Test 120VAC power loss alarm
   d. Test for communication loss with server reporting
2. Test power stand-by provisions (UPS, battery backup, generator backup)
3. Testing Electronic Access Control Doors
   a. Doors with Door Position Switch (DPS) and Request to Exit device (REX) shall be tested for:
      1) Door Forced Open alarm is generated when door is opened from unsecured side
      2) Door Held Open alarm is generated when door is held open past its preprogrammed duration after valid REX event
      3) REX shunts alarm on egress
      4) REX does not shunt forced door alarm
b. Doors with Electrified Exit Device, DPS and REX
   1) Door is locked in secure mode
   2) Door is unlocked by manual command from system workstation
   3) Door is unlocked by time zone
   4) Door Forced Open alarm is generated during secure mode only
   5) Door Held Open alarm is generated during secure mode only
   6) REX shunts alarm on egress during secure mode, for the preprogrammed duration
   7) Door relocks immediately when door closes after valid passage (does not wait for preprogrammed duration)
   8) REX does not unlock door
   9) REX does not bypass forced door alarm
  10) Door relocks on time zone
  11) Door relocks during day mode on manual command from system workstation.

c. Doors with Automatic door operators
   1) Door is locked in secure mode
   2) Door is unlocked by manual command from system workstation during secure mode
   3) Door is unlocked by time zone
   4) Door Forced Open alarm is generated during secure mode only
   5) Door Held Open alarm is generated during secure mode only
   6) REX shunts alarm on egress during secure mode
   7) REX does not unlock door
   8) Door relocks on time zone
   9) Door relocks during day mode on manual command from system workstation.

d. Doors or Gates with card reader
   1) Door unlocks by use of the card reader for programmed unlock time and does not alarm when door is opened
   2) Door is locked in secure mode
   3) Door is unlocked by manual command from system workstation
   4) Door is unlocked by time zone
   5) Door Forced Open alarm is generated during secure mode
   6) Door Held Open alarm is generated during secure mode
   7) REX shunts alarm on egress during secure mode
   8) Door relocks immediately when door closes after valid passage (does not wait for preprogrammed duration)
   9) REX for door does not unlock door
  10) REX for gates does not unlock gate
  11) Door relocks on time zone
  12) Door relocks during day mode on manual command from system workstation.

e. Doors with card and/or biometric iris and/or fingerprint reader
   1) Door unlocks by use of the card or iris reader for programmed unlock time and does not alarm when door is opened
   2) Door is locked in secure mode
   3) Door is unlocked by manual command from system workstation
   4) Door is unlocked by time zone
   5) Door Forced Open alarm is generated during secure mode
   6) Door Held Open alarm is generated during secure mode
   7) REX shunts alarm on egress during secure mode
8) Door relocks immediately when door closes after valid passage (does not wait for preprogrammed duration)
9) REX for door does not unlock door
10) Door relocks on time zone
11) Door relocks during day mode on manual command from system workstation

D. Adjustments and Documentation: After successfully energizing and testing the systems, make adjustments, and document the setting of controls, configurations, as applicable. Tabulate all data along with an inventory of test equipment, a description of testing conditions and a list of test personnel.

E. Test Documentation: Create and provide complete test reports documenting the results of the each performed on each device, control panel, power supply, and other elements of the system. Copies of preliminary test data shall accompany copies of performance testing data as part of the Operating and Maintenance submittal.

3.5 PREPARATION FOR ACCEPTANCE (PRIOR TO FINAL INSPECTION)
A. Temporary facilities and utilities shall be properly disconnected, removed, and disposed of off-site.
B. Systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
C. Materials shall be neat, clean, and unmarred, and parts securely attached.
D. Broken work, including glass, raised flooring, and supports, ceiling tiles and supports, walls, doors, etc., shall be replaced or properly repaired, and debris cleaned up and appropriately discarded.
E. Extra materials as specified shall be delivered and stored at the premises as directed by the Owner at the completion of the phase.
F. Preliminary Test reports of each system and each system component, and Record project documents shall be complete and available for inspection and delivery upon completion of each phase as directed by Owner.

3.6 ACCEPTANCE TESTING AND ADJUSTING PROCEDURES
A. Purpose: Conduct testing and adjusting procedures to realize and verify the performance criteria specified herein and identified in Preliminary Testing procedures listed above. Successfully demonstrate the acceptable performance of each specified system in the presence of the Owner and Engineer.
B. Scope: Conduct all performance testing, adjustment, and documentation procedures to verify and realize compliance with the performance specifications herein. Make available at least one (1) engineer familiar with this work, and all required test equipment for the duration of performance testing verification, at the convenience of the Owner.
C. Acceptance Testing Readiness: Acceptance testing will be performed after the system is installed and pre-tested completely.
1. The contractor shall have successfully tested the system prior to scheduling formal acceptance testing and provided forms with each test for each portal. Contractor shall correct any and all deficiencies found at that time.
2. Acceptance testing will be conducted in accordance with the approved Acceptance Testing Plan with a minimum of testing listed in Preliminary Testing section.
3. Deliver equipment, devices and materials required for the access control work to the site at least fourteen (14) working days prior to the scheduled Completion Date.
4. Install, test and ready all of the access control work for final Acceptance Testing of the Installation ten (10) working days prior to the Completion Date.

D. Acceptance Testing Schedule: Contractor shall confirm in writing to the Owner when the system is ready for acceptance testing. Contractor shall then schedule a complete Acceptance Test at the convenience of the Owner.

E. Acceptance Testing
   1. Contractor shall test and verify the performance of all equipment, systems, interfaces and peripheral equipment in the presence of the Owner and Engineer.
   2. Tests shall be performed in accordance with the requirements of individual systems as specified herein and in related specification sections. Test shall incorporate testing described in preliminary inspection and testing.
   3. Contractor shall furnish communication equipment between the field testing team and the monitoring team.
   4. Contractor shall furnish testing forms for each location.

F. An Observation Report will be generated by the reviewing team, Owner, Design Engineer and Contractor for contractor to review.

G. Correction of Jobsite Observation Report Items: Perform any and all remedial work to correct inadequate performance or unacceptable conditions of, or relating to any of this work, as determined by the Owner within ten (10) working days of the completion date. Corrective work shall be performed at no additional cost to the Owner. Contractor shall provide a written report each week of repairs made and plan to complete repairs in progress.

H. Test Documentation: Document all acceptance testing, calibration and correction procedures described herein with the following information:
   1. Performance date of the procedure
   2. The names of personnel conducting the procedure
   3. The equipment used to conduct the procedure
   4. Type of procedure and description
   5. Condition during performance of procedure
   6. Parameters measured and their values, including values measured prior to calibration or correction as applicable

3.7 BURN-IN PERFORMANCE PERIOD

A. Prior to Final Acceptance by the Owner, the Contractor shall be responsible for performing testing and inspections, as specified herein, to verify that the installation equipment and materials are performing in compliance with the specifications.

B. Upon satisfactory completion of Acceptance Testing and inspection, the Owner shall notify the Contractor, and the Burn-In Performance Period shall commence.

C. Contractor shall obtain weekly reports of alarm events related to this project and make system repairs or corrections to minimize false alarms. A report shall be provided by the Contact to the Owner indicating corrections required and locations corrected. Engineer may provide additional comments to the report for contractor to review and provide corrective action.

D. A Performance Period of thirty (30) consecutive calendar days of operating without fault in accordance with the specifications, subsequent to testing and inspection, shall constitute a successful Performance Period.
E. Upon successful completion of the Performance Period, the Owner and design team shall meet to confirm Acceptance, and the Final Acceptance Form shall be executed.

F. If a successful Performance Period cannot be accomplished within ninety (90) consecutive calendar days after commencement of the first Performance Period, the Owner reserves the right to find the Contractor in default, and terminate the Contract. In that event, the Contractor shall remove the equipment, and the Owner shall not be responsible for any payment whatsoever to the Contractor, except for any materials (i.e., wiring) left in place and elected to be reused by the Owner.

G. Obtain system alarm and event reports at a minimum of four (4) times during the burn in period. Review reports with Owner and repair system equipment and/or adjust system parameters as requested by the Owner or required for system performance.

3.8 COMMISSIONING AND VALIDATION

A. Commissioning is a “fine tuning” process used for complex systems that occurs after acceptance testing, during the Burn-In Performance period and before final acceptance. It helps assure that the system performs to its fullest potential, and validates the effectiveness of the total system implementation in relation to the goals of the access control countermeasures program.

B. After the installation and final testing of the system, an Access Control Commissioning team will be assembled to validate the best performance of the system under different scenarios. Alarm reports shall be used to verify operation of the system.

C. This process includes participation by the Owner, Contractor, the Consulting Engineer, A third party testing agent may also be hired by the Owner to plan, conduct, and verify the Commissioning process.

D. The Contractor shall include a minimum of sixteen (16) hours of participation in the commissioning and validation process by a minimum of two (2) employees familiar with the specific project and installation. Contractor shall adjust device installation where alarms are determined to be false.

E. Scheduling of Commissioning and Validation testing will be by the Owner, and may occur after the Notice of Completion, but before the end of the Warranty period.

F. Revisions to the configuration and programming of the system which are recommended by the Commissioning Team as a result of validation testing, shall be performed by the Contractor under the direction of the Owner, at no additional charge. The Warranty provisions of this specification shall apply to any configuration and programming revisions resulting from the validation testing process.

G. Revisions and improvements recommended by the Commissioning Team which require physical modifications or additions to the approved and accepted system, including the provision or relocation of new equipment, wiring, and installation, shall be treated as additional changes to the contract, and shall be processed as defined in the Project General Provisions. Where such requested work was part of the Contractors’ original scope of work, as defined in the design drawings and specifications, or in contract revisions and agreements, the Contractor shall provide the work at no additional charge.

3.9 FINAL PROCEDURES

A. Perform final procedures in accordance with Section 28 05 00, Security System General Requirements.
PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification section covers the furnishing and installation of a complete expansion to a campus-wide, low-voltage, electronic access control system (EACS) at MiraCosta College - Community Learning Center.

B. Contractor shall furnish and install access control hardware devices, mounting brackets, power supplies, switches, controls, consoles, and other components of the system as shown and specified.

C. Contractor shall furnish and install access control related software to allow this system expansion.

D. Refer to responsibility matrix on security drawings for scope delineation.

1.2 PRECEDENCE

A. Obtain, read, and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

1.3 GENERAL CONDITIONS

A. In accordance with Section 28 05 00, Security System General Requirements

1.4 RELATED WORK

A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section.

B. In accordance with Section 28 05 00, Security System General Requirements

C. In accordance with Section 28 05 53, Identification for Electronic Safety and Security

D. In accordance with Section 28 07 00, Security System Integration

E. In accordance with Section 28 08 00, Security System Testing and Commissioning

1.5 APPLICABLE PUBLICATIONS

A. In accordance with Section 28 05 00, Security System General Requirements

1.6 SHOP DRAWINGS & EQUIPMENT SUBMITTAL

A. In accordance with Section 28 05 00, Security System General Requirements

1.7 OPERATING AND MAINTENANCE MANUALS

A. In accordance with Section 28 05 00, Security System General Requirements.
1.8 SERVICE AND MAINTENANCE

A. In accordance with Section 28 05 00, Security System General Requirements

1.9 TRAINING

A. In accordance with Section 28 05 00, Security System General Requirements

1.10 WARRANTY

A. In accordance with Section 28 05 00, Security System General Requirements

1.11 TECHNICAL REQUIREMENTS, ELECTRONIC ACCESS CONTROL SYSTEM (EACS)

A. General

1. The following information is provided to establish required system performance for the complete operating EACS access control system. Contractor shall provide equipment, wiring and software programming at all sites as necessary to provide a complete system as described herein and as shown on the drawings.

2. Contractor shall be responsible for providing equipment and software licenses to achieve the specified system performance described herein.

B. Purpose

1. The electronic access control system is designed to monitor and restrict access to specified areas, and to report on the activity and violations of restricted access in those areas.

C. Environment

1. The system shall be wholly contained within MiraCosta College - Community Learning Center facilities. Refer to the drawings and Bid Instructions to determine the scope limitations for this phase of work.

2. Monitoring Post: Existing monitoring post clients are located throughout the MIRACOSTA campus determined by the Owner. Site monitoring, site configuration, and site-related access privilege management may occur at various locations and require owner coordination.

3. Infrastructure and Connectivity

a. Local Sites and Buildings: The EACS workstations and controllers shall reside on the building Local Area Network (LAN) or network segment. Coordinate with the Owner on the provision of LAN ports and network rights for new connections.

D. Attributes

1. General

a. The EACS shall be Lenel Onguard Professional, supporting a sufficient number of access control readers, sufficient number of inputs / outputs, sufficient number of client workstations, and sufficient number of cardholders.

b. The system shall comprise electronic access control system field devices located as shown on the drawings and connected to provide a complete and operational system.

c. The EACS shall be based on a distributed system of fully intelligent, standalone controllers, operating in a multi-tasking, multi-user environment.

2. Electronic Access Control System Description

a. The Electronic Access Control System (EACS) is the key central component for managing physical access control and the bridge between physical and logical access control for this project. The system shall provide a variety of integral functions including the ability to regulate access and egress; provide identification credentials; monitor, track, and interface alarms.

b. The EACS shall be able to seamlessly interface with and monitor Controllers, reader interface modules, I/O panels, burglar alarm panels, burglar alarm panel
receivers, biometric devices, personal protection devices, intercom systems, fire alarm panels (secondary monitoring only), building management systems.

c. The EACS shall be able to communicate with Controllers via RS-485, RS-232, TCP- IP/Ethernet and Dial-up via Modem.

3. EACS Software Capabilities: The EACS Software shall support all needed card readers, input points, video cameras, intrusion detection points, and relay outputs as directed on the security drawings. The EACS database server shall support an unlimited number of cardholders, visitors, and assets limited only by the available memory on the controller. The database server shall also support an unlimited number of system events and System Operator transactions in the history file limited only by available hard disk space. Client Workstations shall be limited only by the limitations of the operating system server software.

4. The Contractor shall incorporate the following application software features and functionality into the work and configure the system and devices to make use of these and any other features offered by the application software, as required by the Owner.

a. Thin client, web server, capable of 10 concurrent connections
b. Time Zones
c. Access Levels
d. Temporary Access Levels
e. Access Groups
f. Holidays
g. First Card Unlock
h. Database Segmentation
i. Field Hardware Communications
j. Dual Path Field Hardware Communication
k. Multi-Drop Panel Support
l. Area Control
m. Global Input / Output / Event Linkage
n. Cardholder Use Limits
o. Extended Individual Strike Times
p. Extended Individual Door Held Open Times
q. Extended, on Demand, Door Held Open Times
r. Elevator Control
s. Graphical System Overview Tree
t. Alarms:
   1) Pre-Alarm
   2) Alarm/Event Logging
   3) Monitor Zones
   4) Alarm/Event Routing
   5) Text Instructions
   6) Alarm Attributes
   7) Alarm-Event Mappings
   8) Alarm Masking Groups
   9) Input Control Module (ICM)
  10) Current Status Indication
  11) Color Coding for Alarm Priorities
  12) Pre-Defined “Canned” Alarm Acknowledgment Responses
  13) Alarm Monitoring – Column Display & Configuration
  14) Test Mode
  15) Alarm Filtering
  16) Alarm Masking
  17) On-Line Context Sensitive Help
  18) Sorting Capabilities
u. Device Group Support
v. Scheduling Utility
w. Access Control:
   1) Denied Access Attempts Counter.
   2) Card Reader Time Zone Overrides
   3) Card Reader Options
x. Manual Control
y. Real-Time, Dynamic Graphical Maps

5. The Contractor shall add new applications, features, functionality, and options specified herein for the work, and configure the system and devices to make use of these applications, features, functionality, and options, as required by the Owner.

E. Controllers
1. The Controller shall link the EACS Software to all “down-stream” field hardware components. The controller shall provide full distributed processing of access control / Alarm Monitoring rules and operations. A fully loaded and configured controller shall respond in less than one-half (0.5) second to grant or deny access to cardholder.
2. The controller shall continue to function normally (stand-alone) in the event that it loses communication with the EACS software. While in this off-line state, the controller shall make access granted/denied decisions and maintain a log of the events that have occurred. Events shall be stored in local memory, and then uploaded automatically to the EACS database after communication has been restored.
3. The Lenel Controller shall incorporate the following features
   a. FCC Part 15, CE, RoHS, UL 294, UL 1076, ULC CSA-C22.2, CAN/ULC-S319-05, cUL/ ORD-C1076
   b. On-board Ethernet 10/100Base-T port provides up to 8 times greater throughput than serial-to-Ethernet converters.
   c. DHCP and fixed IP addressing supported.
   d. DNS device naming through DHCP extended commands
   e. 6 MB of available on-board, non-volatile flash memory
   f. Battery-backed, non-volatile storage of 50,000 events
   g. Firmware stored in flash memory, background download of firmware updates supported
   h. Supports up to 16 different formats (8 card formats and 8 asset formats)
   i. Biometric template storage support for Schlage Recognition Systems®, Bioscrypt®, and Identix®.
   j. Direct connection of Bioscrypt RS-485 devices
   k. Enhanced anti-passback capabilities
   l. Up to 32,000 access level permissions
   m. 255 holidays with grouping, 255 timezones, each with 6 intervals
   n. Elevator control support for up to 128 floors
   o. Individual extended held open and strike times (ADA required)
   p. Up to 9-digit user PIN codes • 20 status LEDs
   q. 2 dedicated inputs for tamper and power failure status
   r. 12 or 24 VDC input power
   s. Advanced Encryption Standard (AES) 128-bit algorithm for communications

F. Intrusion Detection System (IDS) and Integration
1. Intrusion panel shall be installed and wired to the EACS system for functionality listed herein.
   a. Intrusion system consists of:
      1) Intrusion Control Panel, keypad, motion detectors, arming readers, door contacts, communication modules and I/O modules.
   b. Functionality
      1) The EACS system shall integrate with the Intrusion control panel to provide separate IDS arming/disarming reader installed adjacent to IDS keypad installed outside the MiraCosta College - Community Learning Center.
      2) First valid card read of the day from any exterior card reader deactivates the IDS system for the building, including arming/disarming reader at IDS keypad.
      3) Complete programming, setup and testing of RPS software is required
PART 2 - PRODUCTS

2.1 GENERAL

A. Product Acceptability: The Products section contains lists of acceptable products. If product substitutions are proposed, they must be made based upon a comparison of equivalence to the product specified and compatible with the proposed system. Considerations may include but shall not be limited to functional, physical, aesthetic and/or interface aspects. The Owner shall be the sole judge of whether or not a submitted substitution is deemed to be "equivalent" to that specified. Contractor may not use contractor proprietary interface modules for connections between field devices and controller.

B. The following products are District Board approved Sole Source items. See Section 016000 Product Requirements. No substitutions shall be accepted.
1. Access Control Panels: Lenel models LNL2220 and LNL1320.
3. Intrusion System Control Panels: Bosch model GV4

C. Equipment shall have a UL Listed mark on the product.

2.2 ELECTRONIC ACCESS CONTROL EQUIPMENT

A. System: Lenel Onguard Professional, Electronic access control system, configured as described herein.

B. Software
1. Operating System: Microsoft Server 2008, Windows 10, or other standard operating system, as required by the proposed system. Version and configuration shall be as recommended by the manufacturer, based upon compliance with these specifications.
2. Custom/User Configuration: Provide new programming as required to perform alarm, control, interface, map, graphic and database functions described herein.

C. System Controller Panels: Provide sufficient controllers and input/output boards to meet all requirements of specifications at each building.
1. Lenel EACS Controller
   a. All panels will be Lenel LNL-2220 Series controllers with Lenel LNL-1320 (2-reader panels) At wall-mount enclosures, provide boards only mounted to removable backplanes of enclosures.
   b. Each LNL-2220 panel will be individually connected to the network and will not be connected to additional panels using RS-485.
   c. Contractor shall review drawings and specifications with the Owner and Engineer, they may propose changes to the topology of the system based on device layout, where such changes improve performance or functionality of the system. The Owner has final authority as to the final approach for system topology.
   d. Controller Connectivity
      1) Controllers shall support connection to the access control LAN/WAN using TCP/IP protocol, and shall also support connection to the manufacturer’s standard data communications protocol (RS-232, RS-485, or RS-422).
      2) Connectivity shall be monitored by the system and report loss of communications and restoral of communications. Controller shall retain in memory events and communicate events during loss of communications to the system upon restoral of communications.

2. Equipment Modules: Provide reader, input, and output control capacity at each controller location, to meet the requirements of the site configuration.
   a. Door controller: LNL-1320 Series 3 dual reader interface module
   b. Remote Input Board: LNL-1100 Series 3 input control module
   c. Output Board: LNL-1200 Series 3 output control module
D. Access Control Readers: Provide compliant proximity card readers where shown on the drawings and indicated within these specifications ensuring compatibility with the smart card technology embedded in the cards provided as part of this contract. Card readers shall be "single-package" type, combining controller, electronics, and antenna in one package:

1. Provide black HID Multiclass SE RP40 reader, part # 920PTNNEK00000
   a. Multi-Technology Reader: Multi-technology contactless reader shall read access control data from both 125 kHz and 13.56 MHz contactless smart cards. The multi-technology contactless reader shall be optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards meeting the following requirements:
      1) Compatible with HID 125kHz proximity identification media.
      2) Compatible with Secure Mifare and DesFire identification media, including the Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
      3) Secure access control data exchange between the smart card and the reader utilizing diversified keys and mutual authentication sequences.
      4) Optimal read range and read speed for increased access control throughput.
      5) Suitable for both indoor and outdoor applications.
      6) Customizable behavior for indicator lights and beeper.
      7) Multi-technology contactless reader shall comply with the ISO 14443 13.56MHz-related standard.
      8) Configurable to read data from any compatible 125 kHz technology simultaneously with 13.56 MHz data.
      9) Provide the ability to read card access data stored in the secure access control sector/application area of the ISO 14443 XceedID MIFARE or MIFARE DESFire EV1 card.
     10) Configurable to provide compatibility with all standard Prox formats up to 37 bits (including Corporate 1000®).
     11) Reader firmware may be upgraded in the field without the need to remove the reader from the wall through the use of factory-provided device.
     12) Compliant with the SIA AC-01 Wiegand standard.
     13) Reader shall provide the ability to transmit an alarm signal via an integrated optical tamper switch if an attempt is made to remove the reader from the wall.
     14) Reader electronics shall be enclosed in a full potted assembly and provided with a quick connect wire harness.
     15) Audio/visual indications shall include:
         a) An audio beeper shall provide tone sequence to signify: access granted, access denied, power up, and diagnostics.
         b) A light bar shall provide clear visual status (red/green/amber).
     16) Multi-technology contactless reader shall be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Contactless smart card power requirements shall be:
     17) Operating voltage: 5 – 16 VDC, reverse voltage protected. Current requirements: 160 mA DC, 195 mA PEAK @ 12 VDC
     18) Multi-technology contactless reader shall meet the following physical specifications:
     19) Color: Black, Gray, Brown or Cream as approved by the project architect.
     20) Weatherized design suitable to withstand harsh environments
     21) Certified rating of IP65
     22) Multi-technology contactless reader cabling requirements shall be:

   b. Wall Mounting
   1) Provide “single-gang” mounting style readers for wall and stanchion mounting, where shown on plans.
   2) The reader shall have an approximate read range of up to 3” when used with the proximity access card.
   3) Provide HID Multi Class SE series card reader, or acceptable equal.
2. Provide / coordinate provision of reader licenses for each door with electronic hardware controlled by the system.

E. Access Control Devices
1. Provide devices as required:
   a. Controller Power Source
      1) Provide: Altronix EFLOW6N single output power supply
      2) Derive primary controller 120VAC power from a designated power source in a secure location, or as shown on plans.
      3) Power cable shall be protected by conduit.
      4) Transformers shall be installed in locked cabinets, protected by tamper switches. Plug-in transformers which are not protected by locked cabinets are not acceptable.
      5) Serve all low voltage powered devices from the Electronics Power Supply.
      6) Provide barriers as may be necessary to separate Class I from Class II power.
   b. Electronics Power Supply
      1) Provide Altronix AL600ULX-PD8, AL1024ULX, PD4A & Maximal77 UL Listed Class II power supplies as required.
      2) Capacity: The power supply shall be capable of powering a minimum of 125 percent of the load required at the time of acceptance (25% spare capacity).
      3) Power Monitoring: The system shall monitor the loss and restoration of power at the controller of both primary and secondary loss of power. Loss and restoration of power shall be displayed at the console but shall not require resetting of the system.
      4) Battery Back-up: Provide battery back-up to retain functions of all electronics for a period of four (4) hours upon loss of 120VAC power.
      5) Transformers shall be installed in locked cabinets, protected by tamper switches. Plug-in transformers which are not protected by locked cabinets are not acceptable.
   c. EACS Alarm Input Board: As required for connection to alarm initiating devices shown connected at this location.
   d. EACS Output Control Board: As required for connection to controlled devices shown connected at this location.
   e. Terminations: Provide connections to labeled screw barrier terminal blocks.

F. Lock Power Supply (LPS)
1. Provide Altronix, UL Listed Class II power supplies within a ventilated, locked, cabinet where indicated on the contract drawings, or as otherwise required to affect proper system performance. Cabinet shall be equipped with a tamper switch, which shall be connected to the EACS to provide a supervisory alarm. Power supply shall include separate terminals for each door lock. Power supply voltage shall be as required by the hardware supplied locks.
2. Capacity: The power supply shall be capable of powering 200 percent of the load required at the time of acceptance (100% spare capacity).
3. Power Monitoring: The system shall monitor the loss and restoration of power at the controllers. Restoration of power shall be displayed at the console but shall not require resetting of the system.
4. Battery Back-Up: Power supplies shall be equipped with integral battery recharging circuits and batteries. If a separate cabinet is used for batteries, the cabinet shall be locked and provided with a tamper switch connected to the EACS.
   a. Fail Safe Door Locks: Provide 4 hours of battery backup for low-voltage electrified door hardware.
   b. Fail-Secure Door Locks: Provide battery backup sufficient to operate fail-secure door locks 100 times per hour, for four hours.
5. Power supply output may be connected to a remote UL-approved distribution board.
   a. Provide LV-8RS / LV-8A distribution modules as required.
   b. Distribution modules shall be mounted in a power cabinet.
      1) Model LVPC 26x20x07
6. Provide a Fire Alarm Interface Relay to interface the LPS to the controller and Fire Alarm System, as required by code.
7. Transformers shall be installed in locked cabinets, protected by tamper switches. Plug-in transformers which are not protected by locked cabinets are not acceptable.

G. Lock Power Supply (LPS for Latch Retraction Exit Devices)
   1. Provide Command Access Technologies, UL Listed power supplies (Model PS-2 or PS-5) within a ventilated, locked, cabinet where indicated on the contract drawings, or as otherwise required to affect proper system performance. Cabinet shall be equipped with a tamper switch, which shall be connected to the EACS to provide a supervisory alarm. Power supply shall include separate terminals for each door lock. Power supply voltage shall be as required by the hardware supplied locks.
   2. Capacity: The power supply shall be capable of powering 200 percent of the load required at the time of acceptance (100% spare capacity). Provide the appropriate number of output channels to support the installed devices, plus expansion channels.
   3. Power supplies shall be sized to be capable of powering all units at the same time.
   4. Power Monitoring: The system shall monitor the loss and restoration of power at the controller. Restoration of power shall be displayed at the console but shall not require resetting of the system.
   5. Solid-state inputs and outputs.
   6. Battery Back-Up: Power supplies shall be equipped with integral battery recharging circuits and batteries. If a separate cabinet is used for batteries, the cabinet shall be locked and provided with a tamper switch connected to the EACS. Size the batteries in accordance with the following rules.
      a. Fail Safe Door Locks: Provide 4 hours of battery backup for low-voltage electrified door hardware.
      b. Fail-Secure Door Locks: Provide battery backup sufficient to operate fail-secure door locks 100 times per hour, for four hours.
   7. Provide a Fire Alarm Interface Link to interface the LPS to the controller and Fire Alarm System, as required by code.
   8. Used with Command Access PM300 latch retraction device modules, and other compatible lock types.

H. Alarm Initiating Devices
   1. Door Position Switch: Door Position Switches shall be furnished and installed by the Contractor. The Contractor shall align, prepare and fabricate doors and frames to accept specified door position switches. The Contractor shall be responsible for coordinating the installation, so systems and hardware operate as specified.
      a. Surface Mounted Door Switch:
         1) GE 2500 series Form A or approved equal Surface Mounted Magnetic Switch with armored cable. Route armored cable to junction box and permanently secure to box with clamp or set-screws. Use only where flush mounted devices cannot be installed.
      b. Flush Mount:
         1) Sentrol 1076D-G (DPDT) Concealed Magnetic Door Switch.
      c. Gates and Roll-Up Doors:
         1) Sentrol 2205A Floor Mount Contact Extra Heavy Duty, with armored cable. Route armored cable to junction box and permanently secure to box with clamp or set-screws.

I. Exit Request Detector:
   1. Coordinate with the door hardware vendor and use the provided Exit Request Touch Bar or integral lock signal switch, as specified in Division 08.

J. Lock Down Button:
   1. Lock down button shall be furnished and installed by the Contractor. Upon first valid card read into room, door will remain unlocked via EACS programming. The momentary Lockdown button shall be connected as input to EACS system and upon activation,
trigger relocking of door(s) of room containing Lockdown button only. Valid card read will reopen door. The Contractor shall be responsible for coordinating the installation, so systems and hardware operate as specified.

a. Provide STI SS2324LD-EN white, momentary pushbutton with shield.

K. EACS Lenel Product Licenses
   1. Provide PRO64RUP reader license bundle
   2. Provide 1-year Lenel Software Support License SUSP-PRO-TR-2

2.3 INTRUSION SYSTEM

A. Purpose: The intrusion panel will be used as a communicator to local authorities for EACS events defined herein.

B. Environment:
   1. The system shall be wholly contained within the MiraCosta College - Community Learning Center facility. Refer to the drawings to determine the scope limitations for this work.
   2. Security Alarm Monitoring: Security alarm signals shall be transmitted to the local authorities via WAN or telephone lines provided by the Owner. Trouble signals shall be sent to the EACS system and displayed as events.
   3. Intrusion panel shall be armed and disarmed via Lenel access control card reader credentials and database.

C. Attributes
   1. System Control Panel
      a. System Software: The base panel shall come complete with the software necessary to implement every system feature and to allow for the addition of every expansion or functional module without changes or addition to the basic software.
      b. The system shall be U.L. listed for Central Station, Local and Auxiliary, and Burglary (UL Central Station and Local) applications.
      c. Voice-Assisted Status & Control: The system shall be capable of providing system status and control via any local or remote tone telephone, with the system providing system status information by voice. The system shall include a pre-recorded word library from which words can be selected to create zone labels.
      d. System shall bear the following listings as necessary to meet the requirements of governing authorities:
         1) UL1610 Central Station Burglar Alarm Units
         2) UL609 Local Burglar Alarm Units
         3) UL365 Police Station Burglar Alarm Units
         4) UL1635 Digital Alarm Communicator System Units
      e. Parts:
         1) Provide: D7412GV4 panel
            a) Provide: UL Listed battery backup within the system control panel to retain all functions of the electronics for a period of (12) hours upon loss of 120VAC power.
            b) Provide: tamper switch
         2) Provide: D8125 Popex Zone Expanders, D9127U POPITs and other necessary input/output boards as required to per the specification and drawing requirements.
         3) Provide: (3) Bosch Keypads D1260 mounted in environmental enclosure as shown on the drawings.
            a) Provide: STI-7511B outdoor enclosure at each keypad location
         4) Provide: Bosch B426 EtherC.1.net Communication Modules
         5) Provide: Bosch DS9370 Ceiling Mounted Motion Detectors
         6) Provide: (3) Bosch RPS Dongles
         7) Provide: SWG-1450 API license for Lenel to Bosch communication
2.4 WIRE AND CABLE

A. General: Cables which are not installed in conduit shall be a version of the specified cable rated for use in plenums.

B. System cable: Provide cable as shown below, or as recommended by the Manufacturer.
1. Composite Cable (Reader, Lock, Monitor, REX): Belden P/N 658AFS jacketed Plenum cable with overall shield, including 6-Conductor Shielded 22AWG w/ripcord, 4-conductor 22AWG w/ripcord, 2-Conductor 22AWG w/ripcord, and 4-conductor 18 AWG w/ripcord; or equal with approval by Owner
2. Card Reader Cable for single Intrusion arming/disarming card reader: Tappan Wire and Cable P/N P29929, 3 Pair Shielded 22AWG or approved equal.
3. Intrusion door contact: Belden P/N 6502FE Jacketed Plenum cable, shielded 4 conductor 22 AWG or approved equal.
4. Area Motion Detector: Belden P/N 6502FE Jacketed Plenum cable, shielded 4 conductor 22 AWG or approved equal.
5. Network Cable: As specified in 27 15 00.

C. Cable installed below grade shall be rated for immersion in water.

PART 3 - EXECUTION

3.1 GENERAL

A. In accordance with Section 28 05 00, Access Control General Requirements.

3.2 SPECIAL INSTRUCTIONS

A. Door Hardware Coordination
1. Doors shall not be locked in path of legal egress.
2. Refer to Section 08 71 00 for door hardware requirements and coordination. Contractor shall work directly with door hardware supplier to ensure the provision of specified mechanical functionality.
3. Refer to Section 08 71 00 for electrified door hardware requirements and coordination. Security Contractor shall provide, install and terminate all electrified door hardware in conjunction with mechanical hardware by others.
4. See Section 08 71 00 for hardware specified, consult door hardware consultant for clarification:
   a. All lock hardware is to include integral request to exit (REX) switch.
5. Security contractor to provide and install required lock power supplies for all electrified door hardware. Coordinate AC power requirements with electrical contractor.
6. Request-To-Exit Activation: Contractor shall configure system such that Request-To-Exit devices and System Controllers will react quickly enough to bypass alarms before a fast-moving individual can reach and open the door. This bypass process shall be evaluated and verified by the Contractor on the fully configured and operational EACS system, prior to acceptance testing.
7. Fire Alarm Interface: Electrified locks and strikes which are part of this work and which may be locked in the path of legal exiting, shall be connected to the building Fire Alarm System in accordance with AHJ requirements such that they automatically unlock in the event of activation of the Fire Alarm System. This shall occur whether the activation is a result of a manual pull station, smoke detector or sprinkler flow switch.
   a. A fire alarm “general/common alarm relay” shall be programmed at the fire alarm control panel to activate the EACS interface relays located in each Lock Power Supply cabinet. The Access Control Contractor shall research and provide all necessary fire alarm system conduit, wire, hardware, and programming to perform the required interface.
   b. This interface shall not depend on the EACS Host or Remote Controllers for its operation. Locate these interface relays electrically ahead of lock power...
distribution as shown on the drawings. The Contractor shall supply and install programmed alarm interface relay(s) with sufficient capacity to control the power supplied to all controlled locks.

B. Access Control and Lock Configuration

1. Secured Doors: Doors equipped with electric locks shall be individually programmed for locking and unlocking at specific times of the day. A valid credential presented at a reader will allow the portal to unlock for a programmed period of time.

2. Stairwell Door Locks
   a. Stairwell doors which are locked from the stairwell side shall have the capability to be simultaneously unlocked upon a signal from the Fire Command Center, Fire Alarm Panel, or the Access Control Command Center.
   b. Stairwell locking systems shall, in all respects, comply with the requirements of the California Building Code, “Means of Egress”.
   c. Contractor shall provide clearly labeled switches, in the required locations, to unlock all stairwell doors simultaneously. Coordinate wall or desk mounted switch style, with the Owner and the Authority Having Jurisdiction.
   d. This interface shall not depend on the EACS Host or Remote Controllers for its operation. Locate interface relays for each stairwell door electrically ahead of EACS lock control, to independently override EACS control.

3. Upon authorization by card reader or manual means, “door force” and “door held open” alarms associated with the portal shall be automatically bypassed (prevented from reporting an alarm) for a duration of time that is programmable on an individual door and individual cardholder basis.

4. The door shall re-lock immediately upon closing, after an authorized access, and the bypass duration shall be immediately truncated. A door position switch will be required at every door for this purpose. The same door position switch shall be used to sense the position of the door for “door forced” and “door held open” alarms.

5. Free Egress Authorization
   a. Unless otherwise shown on the plans or described herein, the system shall detect the normal egress of a user at any individual portal and shall bypass any alarm associated with the portal for a duration of time that is programmable on an individual door and individual cardholder basis.
   b. Timing shall be independently programmed for each portal during the initial enrollment process. This function allows extended timing for disabled persons to pass through a portal.
   c. The timing function shall automatically truncate after an adjustable period (0 - 4 seconds) after a portal is closed. This feature allows a subsequent alarm at the portal to be detected and prevents the portal from being re-opened without an authorized request.
   d. “Request-to-Exit” devices shall be used to signal the system that an individual is ready to exit the secured door. Request-to-Exit devices may include but not be limited to
      1) Integral Lock Handle Signal Switches
   e. On doors with integral electro-mechanical locking mechanisms (strikes, electrical panic hardware, or electrical mortise locks), the mechanical action of the door hardware shall enable egress without requiring release of the electrical mechanism. The Request-to-Exit device shall not unlock the door.

C. Sequences: Verify each door type sequence at each door with the Owner.

1. Doors with Door Position Switch (DPS) and Request-to-Exit (REX) devices
   a. DPS and REX contacts shall be wired to EACS auxiliary input. Configure the EACS to mask the associated DPS alarm for a minimum of 45 seconds. Coordinate the required masking duration with the Owner.
   b. EACS shall report a “door forced” alarm when any time the door is opened without a valid REX request. The subsequent operation of an associated REX shall not abort a “door forced” alarm already sensed by the system.
   c. EACS shall report a “door-held-open” alarm after the door has been opened and the masking duration has ended.
2. Doors with Electronic Locking (EL), DPS and REX devices
   a. DPS and REX contacts shall be wired to EACS auxiliary input. Configure the EACS to mask the associated DPS alarm for a minimum of 45 seconds. Coordinate the required masking duration with the Owner.
   b. Electronic lock shall be wired to EACS auxiliary output. Configure the EACS to mask the associated DPS alarm during timed or commanded unlock.
   c. Electronic lock shall be locked and unlocked based on preprogrammed schedules and conditions, and by manual control from the EACS client workstations.
   d. EACS shall not cause an alarm event when door is unlocked.
   e. EACS shall report a “door forced” alarm when any time the door is opened without a valid REX request. The subsequent operation of an associated REX shall not abort a “door forced” alarm already sensed by the system.
   f. EACS shall report a “door-held-open” alarm after the door has been opened and the masking duration has ended during locked mode.
   g. REX device shall not unlock the door.

3. Doors with Card Access Control (CR) and/or Biometric Reader(s), EL, DPS and REX devices
   a. CR or Biometric Reader(s), EL, DPS and REX devices shall be wired to a door controller board.
   b. Electronic lock shall be locked on command from the system at any time.
   c. Electronic lock shall unlock during a preset time zone or from the system.
   d. Electronic lock shall be unlocked and shall not require use of a reader during timed unlock mode.
   e. EACS shall not report activity when door is unlocked.
   f. During locked mode Card Reader and/or Biometric Reader shall unlock the door, mask DPS preventing alarm.
   g. EACS shall report a “door-held-open” alarm after the door has been opened and the masking duration has ended.
   h. EACS shall report a “door forced” alarm when any time the door is opened without a valid REX request. The subsequent operation of an associated REX shall not abort a “door forced” alarm already sensed by the system.
   i. REX device shall not unlock door.

4. Doors with Auto-Operators, Proximity CR, and/or Biometric Reader(s), EL, DPS and REX devices
   a. Auto-Operator controls CR, Biometric Reader(s), EL, DPS and REX devices shall be wired to a door controller board.
   b. Electronic lock shall be locked on command from the system at any time.
   c. Electronic lock shall unlock during a preset time zone.
   d. EACS shall not report alarm activity when door is unlocked.
   e. Day mode: proximity card reader and/or Biometric reader shall activate the auto operator to open the door.
   f. Secure mode:
      1) Reader, auto operator function, shall activate the auto door operator at all times.
      2) Reader shall unlock the door, mask the DPS device preventing alarm and allow use of door open pushbuttons. Electronic lock to be unlocked prior to door open mechanism is engaged. Where auto door equipment is not provided with door open pushbuttons, the door shall automatically open after unlocking.
   g. EACS shall report a “door-held-open” alarm after the door has been opened and the masking duration has ended during locked mode.
   h. EACS shall report a “door forced” alarm when any time the door is opened without a valid REX request. The subsequent operation of an associated REX shall not abort a “door forced” alarm already sensed by the system.
   i. Use of push plate shall activate the EACS REX, unlock the door and operate the auto door system.
   j. Door shall report a door held open time when REX (push plate or signal from the door operator) is activated, door is opened from the secured side and the system bypass time has expired during locked mode.
k. Verify interior push plate is operational in both locked and unlocked modes
l. Verify exterior push plate is operational during unlocked mode
m. Verify exterior push plate is non-operational until valid card read during locked mode
n. Verify exterior push plate is operational after valid card read during locked mode

D. Electrical Connections to Door Hardware: Wire connections to door hardware pigtail leads shall be made using the manufacturer-provided quick-connect devices, or by Dolphin insulated displacement connectors. Wire nuts and splices are not acceptable.

E. Tamper Devices
1. Terminal cabinets, equipment cabinets, enclosures, power supply cabinets, exposed wireways, and pull and junction boxes with wire connections or splices located in public or multiuse locations shall be equipped with tamper switches programmed to report an alarm. Equipment contained within a security managed zone such as an IDF room do not require tamper alarms/switches.
2. Junction boxes requiring tamper switches that are associated with an individual alarmed device (such as a door position switch) may report to the respective device alarm point, if end-of-line resistors and the system are configured to support 6-state alarm reporting. Other cabinet and box tamper switches shall report as independent alarm points.
3. Power Supply/Battery Chargers: Power supply/battery chargers shall be connected to alarm monitoring points to provide an "Event" indication of tamper, power failures and other system troubles.

F. Duress Alarms
1. Duress alarms shall be wired to inputs on the EACS system. The EACS system shall provide alerts in the event of an alarm signal and call up the nearest camera. EACS system shall output duress alarms as security alarms in the Intrusion System panel. The Intrusion panel shall be configured to communicate to local authorities via Owner’s WAN or telephone line. Coordinate connection with Owner.

G. EACS Connectivity
1. Access Control Network: EACS Servers, Client Workstations and Controllers shall reside on the Owners’ Local Area (LAN) and/or Wide Area Network (WAN) to allow global event activity and shared data interchange.
2. Provide and coordinate with Owner IT adequate network “firewalls” to maintain the security of EACS controls and information while connected to shared computer networks and transmission media. Contractor shall coordinate shared resource usage with the Owner and develop network security schemes acceptable to the Owner to ensure the integrity of the EACS.
3. LAN Communications & Connectivity, (Integrated CPU’s and Controller’s):
   a. Provide LAN communications interfaces for the applicable EACS Server, Clients, and Controllers to support multiple workstation and integration schemes that are part of this work.
   b. LAN Communications: Contractor shall utilize the facility’s Local Area Network for EACS connections and interfaces, as shown on the drawings and described herein.
   c. Coordinate with EACS equipment and software manufacturers to provide network interface devices compatible with the established LAN/WAN network.
   d. Coordinate with the MiraCosta College - Community Learning Center Information Systems Department to provide EACS clients, network interface devices, bandwidth utilization, and appurtenances acceptable to the Owner.
4. Controller Communications
   a. Inter-Facility: Between facilities, buildings, and controller “groups”, the controller network shall be implemented utilizing the access control Owners infrastructure and connectivity, as shown on the drawings and described herein.
b. Between controllers at an individual location, and between controllers located within the same building, the controller network may be implemented using standard, twisted, shielded copper conductors as approved by the system manufacturer. It is also acceptable for controllers to be LAN connected, regardless of location.

H. Emergency Standby Power
1. Servers, Computers, Clients, and Other 120VAC Equipment: Provide a UPS with sufficient time for power transfer where the respective buildings have an Emergency Power (EP) source. Where a building EP source is not available, provide sufficient UPS time to allow the system to run for a minimum of 1-Hour, plus (15) minutes to manage the shutdown process.
2. Low-Voltage Equipment: EACS Remote Controllers, peripheral devices and Lock Power Supplies shall also have their own 4-hour battery back-up systems.
   a. Power back-up may be in the form of direct DC battery power back-up or by 120VAC Uninterruptable Power Supplies (UPS), depending upon equipment requirements.
   b. Lock Power Supplies shall allow fail-secure locks to be operated by the system a minimum of 100 times-per-hour, during this time period. Fail-safe locks shall be maintained for the full 4-hours.
   c. Battery back-up systems may be distributed throughout the facility to provide the required emergency power to individual components.
   d. Battery back-up systems shall include battery chargers to keep storage batteries at their peak charge.

3.3 ACCESS CONTROL SYSTEM INTEGRATION

A. Provide access control system integration equipment, software and programming, in accordance with Section 28 07 00, Access Control System Integration. In addition, provide specific integration schemes noted.

B. Intrusion Panel Integration
   1. Intrusion panel shall output trouble alarms to the EACS input board and display trouble alert in the EACS system.

3.4 EQUIPMENT, RACK, AND CONSOLE INSTALLATION

A. Mount equipment in rooms, consoles, equipment racks, and desktops in accordance with Section 28 05 00, Security System General Requirements.

3.5 GROUNDING PROCEDURES

A. Provide grounding of all systems and equipment in accordance with Section 28 05 00, Security System General Requirements.

3.6 WIRE AND CABLE INSTALLATION PRACTICES

A. Provide wire and cable installation in accordance with Section 28 05 00, Security System General Requirements.

3.7 DATABASE PREPARATION, CHECKING AND ACTIVATION

A. Provide database preparation, checking and activation for systems and equipment in accordance with Security System General Requirements, Section 28 05 00.

B. Provide the following special programming services:
1. Contractor shall research with the Owner, develop, and install executive and user software required for the final acceptance of the system as specified herein and on the drawings.

2. Contractor shall provide the Owner with forms and instructions to facilitate the gathering and entry of user software data. Forms shall include but not be limited to information regarding cardholder data, access privileges, time schedules, portal groups, access groups, alarm points, tenant/elevator authorization, password protection levels, two-man and anti-passback locations.

3. Default Access control time zones for each building shall be set as follows:
   a. Normal Business 6 AM to 6PM allowing free access through any portal without creating an alarm event
   b. Card Access Only from 6PM to Midnight by card holders with valid cards.
   c. Restricted Access from Midnight to 6AM for authorized card holders only as programmed by the Owner.

4. Contractor shall ensure LENEL arming/disarming reader located at Intrusion Keypad is properly programmed and integrated to arm and disarm Bosch Intrusion zones as required by owner.

3.8 START-UP RESPONSIBILITY

A. Provide start-up services for all systems and equipment in accordance with Security System General Requirements, Section 28 05 00.

3.9 PRELIMINARY INSPECTION AND TESTING

A. Provide preliminary inspection and testing services for systems and equipment in accordance with Testing and Commissioning, Section 28 08 00.

3.10 SYSTEM PERFORMANCE TESTING AND ADJUSTING PROCEDURES

A. Provide performance testing and adjusting of systems and equipment in accordance with Testing and Commissioning, Section 28 08 00.

B. Electronic Access Control System Testing
   1. Test and verify the normal operation of every alarm point in all four states at each alarm panel. Test each alarm point for the alarm function by normal operation of the alarm point.
   2. Test and verify the normal operation of the Access Control System for each sequence
      a. Minimum testing shall include but not limited to:
         1) Valid Card or Biometric Read (No Alarm)
         2) Electronic lock relock time (Door not opened)
         3) Door held open alarm time (Alarm)
         4) Forced door open (Alarm)
         5) Electronic lock relock on close (Closed within relock time)
         6) REX bypass Alarm on exit
         7) REX does not unlock door
         8) Valid card read during active REX
         9) Associated Camera integration call up during alarm event
      b. Testing shall be recorded on approved forms.
   3. Test each door during its programmed secure time period to assure that the system commands the lock to activate and permits access by valid access card holders within one second from presentation of the access card.
   4. Verify egress systems on access-controlled doors work correctly.
   5. Verify system integration schemes function automatically and correctly.
   6. Verify activity at Client Monitoring Station functions correctly.
   7. Verify operation of auto-door operation.
3.11 BURN-IN PERFORMANCE PERIOD
A. Provide a burn-in performance period to demonstrate the stability of the system, in accordance with Testing and Commissioning, Section 28 08 00.

3.12 COMMISSIONING AND VALIDATION
A. Provide commissioning and validation services to prove and improve the effectiveness of the system, in accordance with Testing and Commissioning, Section 28 08 00.

3.13 TRAINING
A. Provide training requirements of Security System General Requirements Section 28 05 00
B. Contractor shall provide a minimum of two (2) reprogramming training sessions within twelve (12) months of the final acceptance of the system to modify the user programming.
C. User group training shall include:
   1. Building walk-through indicating locations of equipment and their usage
   2. User operation of client workstations, including alarm monitoring, manual door override, card reader reports, and along with user group special operational request.
D. Maintenance group training shall include:
   1. Building walk through indicating locations of equipment and their usage
   2. Location and usage of project specific forms located in the equipment showing relationship between devices and connectivity to the Owners network
   3. Trouble shooting procedures
   4. Operational usage of the equipment
   5. Procedures for obtaining technical service and repair of equipment.

3.14 FINAL PROCEDURES
A. Perform final procedures in accordance with section 28 05 00, Security General Requirements.

END OF SECTION
PART 1 – GENERAL

1.1 The Contractor shall provide new Emergency Pedestal Towers as shown on the drawings, and as described in these specifications including all mounting hardware, concrete pads, connectors, power supplies, and auxiliary equipment as may be required as specified herein and required by the College Facilities and Campus Police Department to meet all their requirements.

1.2 The system shall provide communications and surveillance capabilities. The system will be used in the parking lot and at specific locations shown on the drawings to alert Campus Police of an urgent situation, to direct them to an Emergency Tower with direct access to the Mira Costa College Police Department, and to help the College Police identify victims and perpetrators of unlawful events. The system needs to include the following functionality:

- 1.2.1 Emergency Pedestal Towers
- 1.2.2 Direct Access Communications
- 1.2.3 Video Camera Surveillance

1.3 In summary, the system is a single unit comprised of multiple components. It shall provide interoperability in cases of emergency and direct communication to the Mira Costa College Police Department and any other entity as directed by the College Administrative Department. The system must be expandable to address future development. In addition, the system shall be able to withstand the rigors of the outside elements.

1.4 Required Functions:

- 1.4.1 The requirement here is to provide a clearly recognizable facility wherein the following safety and security services are housed
- 1.4.2 Direct access communications appliance
- 1.4.3 Video camera
- 1.4.4 Future Mass Notification Siren
- 1.4.5 Location light

1.5 The Emergency Pedestal must be weather-resistant and designed to withstand the outside elements. The notification light would be mounted in such a manner to make the Emergency Stand easily and quickly identifiable from anywhere in the immediate and surrounding areas and must comply with county, state, and federal regulations. The other safety and security services are described below.

1.6 Direct Access Communications - Direct access to the Mira Costa College Police Department for voice communications is required. The Emergency Pedestal Tower shall contain a VOIP Call Station that is activated with a single button and upon activation make a direct connection to the Mira Costa College Police Dispatch Center. The VOIP Call Station must be housed in an unbreakable, tamper-resistant appliance designed to withstand the outside elements and to be installed in the Emergency Pedestal. Due to critical time constraints, operations of the VOIP Call Station must be simple and obvious, and upon activation, the Emergency Pedestal and the immediate area around the user must be fully illuminated by the built-in blue colored light.

1.7 VOIP Intercom specifications:

- 1.7.1 Ethernet I/F: 10/100 Mbps
1.7.2 Protocol: SIP RFC 3261 compliant
1.7.3 Power Input: PoE 802.3af compliant
1.7.4 Regulatory Compliance: FCC Class A, UL 60950

1.8 **Video Surveillance Camera at Emergency Pedestal** – All cameras will be furnished and installed by the 28 23 05 Contractor. The cameras shall serve multiple purposes:

1.8.1 The camera will target the area directly in front of the Emergency Pedestal VOIP Call Station showing the caller and the surrounding area upon activation of the direct dial VOIP phone station. The camera shall be installed inside the pedestal, behind the manufacturer’s vandal resistant “window” above the emergency panel. Refer to the detail drawings for the exact location of the camera.

1.8.2 The cameras will provide a live feed to the Mira Costa College Campus Police Dispatch Center or to a local Police Monitoring location designated by the College on the campus for monitoring. In addition, the feed shall be recorded and maintained for 30 days for review and evidentiary purposes.

1.8.3 The camera shall be tied into the College’s existing Milestone Video Surveillance management software program and shall be licensed to operate within that existing camera network system.

1.8.4 The Contractor shall be responsible for installation, set-up and programming of the video surveillance cameras in the Emergency Towers. Coordinate the installation with the District’s IT Department Contact.

1.8.5 Electrical power must be provided to the cameras on a continuous basis and the cameras must be capable of providing a high level of image quality with the parking lot and site lighting system during the hours of darkness.

**Quality Assurance**

1.9 All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer’s complete service notes and drawings detailing all interconnections. The Contractor must also provide complete installation of all wiring and devices or equipment. All conduit and standard backboxes will be furnished and installed by the Division 26 Contractor. Supervised installation of the Emergency Pedestal shall be permitted with the following conditions:

1.9.1 A letter will be required from the manufacturer’s representative certifying that the Emergency Pedestal was completed in compliance with the manufacturer’s recommended installation requirements.

1.9.2 The Emergency Pedestal shall be warranted by the manufacturer’s representative per the contract agreement.

1.9.3 Installation of the Emergency Pedestal shall be provided by a manufacturer’s certified installer.

1.10 The Contractor shall be an established Contractor that has had and currently maintains a locally run and operated business for at least five years. The Contractor shall utilize a duly authorized distributor of the equipment supplied for this project location with full manufacturer's warranty privileges.

1.11 Installation of Emergency Towers shall be furnished by a factory authorized Contractor and distributor. The Contractor shall hold a C10 or C7 license from the State of California
for the purpose of installing Low Voltage systems. The Contractor shall meet the
requirement of the 28 23 05 Section for warranted installations.

1.11.1 Subcontractors shall be approved for the installation of the video surveillance
portion of the Emergency Tower systems only. All other portions of the
installation of the tower shall be provided by an Authorized Installation
company.

1.11.2 Installing Video Surveillance Contractor qualifications for installation of cameras
in/on the Emergency Tower: Firms and their personnel must be regularly
engaged in the installation of video surveillance system cabling and equipment
for systems of similar type and scope. Subcontractor shall provide the
installation and programming of the cameras as described herein.

1.12 The following Contractor's are authorized dealers and installers for the specified
Emergency Pedestals in Southern California;

1.12.1 Electro Specialty Systems (ESS Systems) - Office (XXX)

1.12.2 Simplex Grinnell – George Honaker, (619) 249-5192, e-mail –
ghanaker@simplexgrinnell.com

1.12.3 American Security Group – Preston Gregory, Office (760) 727-4020, Cell (760)
525-4899, e-mail – pgregory@amergroup.com

1.13 The Contractor shall show satisfactory evidence, upon request, that the supplier
maintains a fully equipped service organization capable of furnishing adequate inspection
and service to the system. The supplier shall maintain at this facility the necessary spare
parts in the proper proportion as recommended by the manufacturer to maintain and
service the equipment being supplied.

1.14 Electrical Component Standard: Provide work complying with applicable requirements of
CEC with state amendments including, but not limited to:

1.14.1 Article 250, Grounding.
1.14.2 Article 300, Part A. Wiring Method.
1.14.3 Article 310, Conductors for General Wiring.
1.14.4 Article 725, Remote Control, Signaling Circuits.
1.14.5 Article 800, Communication Systems.

1.15 EIA Compliance: Comply with the following Electronics Industries Association Standards:

1.15.1 Sound Systems, EIA-160.
1.15.2 Loudspeakers, Dynamic Magnetic Structures, and Impedance, EIA-299-A.
1.15.3 Racks, Panels, and Associated Equipment, EIA-310-A.
1.15.4 Amplifiers for Sound Equipment, SE-101-A.
1.15.5 Speakers for Sound Equipment, SE-103

1.16 UL Compliance: Comply with requirements of UL 50. The communication system
supplied shall be listed by Underwriter's Laboratories under UL Standard 1459. A copy of
the UL listing card for the proposed system shall be included with the Contractor's
submittal. The system shall also comply with PCC Part 68 Regulations.

1.17 Installation and start up of all systems shall be under the direct supervision of a local
agency regularly engaged in installation, repair, and maintenance of such systems. The
supplier shall be accredited by the proposed equipment manufacturers and be prepared
to offer a service contract for system maintenance on completion of the guarantee period.
1.18 The agency providing equipment shall be responsible for providing all specified equipment and mentioned services for all equipment as specified herein. The agency must be a local authorized distributor of the specified equipment for single source of responsibility and shall provide documents proving such. The agency must provide written proof that the agency is adequately staffed with factory-trained technicians for the specified equipment.

1.19 The Contractor shall guarantee availability of local service by factory-trained personnel of all specified equipment from an authorized distributor of all equipment specified under this section. On-premise maintenance shall be provided at no cost to the purchaser for a period of two (2) years from date of installation unless damage or failure is caused by misuse, abuse, neglect, or accident.

1.20 Deliver products in factory containers. Store in clean, dry space in original containers. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

1.21 The unit shall be warranted for a period of two (2) years. Reference manufacturer’s warranty for further details.

Support

1.22 Telephone Support: Free telephone support must be provided during normal business hours from the Manufacturer and Authorized Contractor.

Submittals

1.23 Phase I Submittal shall be made in electronic format within (20) working days after the award of the contract by the District. This submittal shall include the following:

1.23.1 Manufacturer’s authorization and Training Certifications required in the specifications for the Contractor and/or company personnel.

1.23.2 Complete Bill of Materials in Excel Spreadsheet format with bills of quantities, including all materials, components, devices, and equipment required for the work. The bills of quantities shall be tabulated respective of each and every system as specified, and shall contain the following information for each Section listed:

1.23.2.1 Description and quantity of each product.

1.23.2.2 Manufacturer’s Name and Model Number.

1.23.2.3 Manufacturer’s Specification Sheet or Cut Sheet.

1.23.3 Specification Item Number referenced for each required product or if not shown in the specifications, Drawing Detail Number being referenced. (ie; Spec. 28 23 05 Item 2.1 or DWG E4.15/#1, etc.)

1.23.4 Include with submittals all warranty information and a description of support and maintenance services to be provided. Also include all licenses and maintenance agreements required for continued operation of the equipment.

1.24 Phase II Submittal shall be provided within (20) working days after the approval of the Phase I submittals and prior to any fabrication or field conduit installations. All shop drawings shall be engineered in a CAD Software. Submission shall include electronic
print copies to match the contract drawings, and Phase II submittals drawings shall include the following.

1.24.1 Emergency Tower elevations will be required to be provided including the position of all components on and within the tower.

1.24.2 Provide shop drawings showing all end device locations, local and site distribution cabling, power connections and operational diagrams.

1.25 Common submittal mistakes which will result in submittals being rejected:

1.25.1 Not including the qualifications of the installing Contractor Company and Contractor’s Staff.

1.25.2 Not including all items listed in the above itemized description.

1.25.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed (provided for the project) or crossing out the items which are not applicable.

1.25.4 Not including actual manufacturer’s cut sheets or catalog information of proposed products.

1.25.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

1.26 The Contractor shall make a written request directly to Johnson Consulting Engineers for electronic drawing files (CAD). As a part of the written request, please include the following information:

1.26.1 Clearly indicate Project Name and Client, Johnson Consulting Job Number (located in bottom left corner of JCE Engineering Stamp) and each drawing Sheet Number required (i.e., E1.1, E2.1, E4.1 etc.).

1.26.2 Identify the name, Company, Title, phone number, mailing address and e-mail address of the person to receive the files.

1.26.3 Detail or Riser diagram sheets, System Schematic drawings or any other drawings other than floor plans or site plans, will not be made available to the Contractor.

1.26.4 Files will only be provided in the AutoCAD format in which they were created (i.e., version 2015 or version 2016). Files will not be made available in REVIT format.

1.26.5 Requests for files will be processed as soon as possible; a minimum of 7 working days should be the normal processing time. The Contractor shall be completely responsible for requesting the files in time for their use and delays in requesting files will not alleviate the Contractor from submitting required documents within the required timeline.

PART 2 – PRODUCTS

Emergency Pedestal Tower System
2.1 General Description

2.1.1 Contractor shall provide the following types of the Emergency Pedestal Towers;

2.1.1.1 Type #A – ETP-MT/R-OP2-NA – Description; ETP-MT/R Tower w/fixed camera mount above VOIP Call Station, integrated LED blue light, VOIP-500 Series Call Station and accessory shelves. The tower must be ordered to allow for future addition of the camera arm to the top of the tower but designating “NA” in the tower’s part number.

2.1.1.2 Type #B – ETP-MT/R-OP4-OP2 – Description; ETP-MT/R Tower with included housing for fixed camera mount above VOIP Call Station, LED blue light on top of the camera arm, VOIP-500 Series Call Station, pre-installed camera arm for PTZ camera at the top of the tower and accessory shelves.

2.1.1.3 Emergency Pedestal Towers shall be as manufactured by Talk-A-Phone (No Approved Equal).

2.1.1.4 Contractor shall provide tower types in locations as shown in project drawings.

2.1.2 The unit shall be a highly vandal-resistant free-standing steel emergency phone pedestal mount and a lighted faceplate.

2.1.3 The pedestal shall house an ADA-compliant communication device manufactured by Talk-A-Phone Model# VOIP-500E Emergency Call Station VOIP telephone.

2.1.1 The LED blue light shall be continuously lit and shall flash for the duration of a call when emergency button is pressed on the communication device. The communication device shall be capable of activating optional peripheral devices (i.e. activating a preset on a PTZ dome camera). Type “A” Tower shall have the blue light built into the top of the tower and Type “B” Tower shall have the blue light on the top of the camera arm.

2.1.2 Both Types of Emergency Towers shall be furnished with a Network IP-Type video surveillance camera mounted inside the tower, just above the call station panel. The camera shall be installed to maximize the coverage and clarity of the image behind the vandal-resistant window in the tower. The camera shall be furnished and installed by the Contractor.

2.1.3 Type “B” Emergency Tower - shall be furnished with the optional camera arm mounted to the top of the tower. The arm shall be able to accommodate a standard dome type PTZ camera with a 1.5” NPT threaded connector. The arm shall extend approximately 4-feet above the top of the tower. The arm shall also accommodate a round flashing blue light on the very top.

2.1.4 Type “B” Emergency Tower - The camera location at the top of the camera arm shall be future and shall be installed by the College District. Contractor shall furnish and install a 1-1/2” NPT cap where the camera would mount to deter insects and birds. The cap shall be painted to match the tower color.

2.1.5 Emergency Towers shall be powered by 120V electrical provided by the Division 26 Contractor. Coordinate the installation of the power with the Electrical Contractor.
2.2 Construction

2.2.1 The Tower shall be constructed of 0.25" thick steel and weigh approximately 340 lbs.

2.2.2 The Tower shall measure 12" W x 10" D x 108" H with a 2" radius on each corner.

2.2.3 A multi-coat, rust-inhibitive coating shall be applied to withstand prolonged exposure to harsh environments.

2.2.4 An internal base plate shall be fully welded within the pedestal 2" above the pedestal base. The base plate shall be fabricated of 0.75" A-36 steel. There shall be a 4" diameter center hole for wiring access and four 1" diameter holes for anchor bolt clearance.

2.2.5 Pedestal shall have a wiring access opening measuring 9" H x 7" W, located 15" above the base of the pedestal. The opening shall have a flush cover plate with a wall thickness of 0.25", held in place by two 10-24 countersunk, tamper-resistant spanner screws.

2.2.6 An opening shall be cut in the front of the pedestal for flush-mounting the VOIP 500-series Talk-A-Phone emergency phone. The lower edge of the opening shall slope down 30º from rear to front, making the edge difficult to use as a shelf yet convenient as a writing surface.

2.2.7 The word "EMERGENCY" shall be emblazoned on all four sides in 3.25" high reflective white letters (custom lettering, sizes and colors available).

2.3 Lighting

2.3.1 Atop the pedestal shall be a flashing LED blue light.

2.3.2 The blue light shall be 7.8-watt high efficiency, all-LED construction light. The unit shall have 70% of initial lumens after 50,000 hours of operation. The unit shall be lit at all times.

2.3.3 The blue light shall have a rating of 209 lumens (peak) and automatically flash 78 times per minute when the emergency phone call is placed and continue flashing until the call has been completed.

2.3.4 The polycarbonate refractor/housing shall have a prismatic pattern to increase visibility at greater distances.

2.3.5 Refractor housing shall further be enclosed in a clear polycarbonate security enclosure.

2.3.6 The unit shall have a concealed ultra-bright LED assembly to illuminate the emergency phone faceplate at all times. LEDs shall have a lifetime of 100,000 hours.

2.3.7 Optional area lighting shall be furnished with the tower provided with the camera arm.

2.4 Electrical
2.4.1 When in use with a VOIP-500E Series emergency call station, the communication device shall require Power over Ethernet (PoE). The call station shall be powered from the Ethernet switch installed in the base of the tower.

2.4.2 **Important Note to Contractor:** When installing the Ethernet Patch cable to the WAN Port on the VOIP Emergency Phone panel, it is essential to have a ferrite core (provided with the phone), installed on to the cable as close as possible to the connector. Make sure the network cable is passed twice through the ferrite core, forming a loop of not less than one (1) inch in diameter. Follow the manufacturer's instructions for the installation of the ferrite core.

2.4.3 The faceplate light shall require 12-120VAC/DC.

2.4.4 Pedestal shall be provided in the 120VAC version.

2.4.5 The standard LED blue light shall require 96-132VAC.

2.4.6 All lamps and fixtures shall be UL and C.S.A. listed. All electrical components shall be hard wired and concealed within the pedestal. All wiring and electrical fixtures comply with the standards of the National Electrical Code, UL and C.S.A.

2.5 Mounting

2.5.1 The pedestal shall be provided with 24-inch J-bolts for mounting into a 24" x 24" concrete foundation, depth to vary according to local regulations and other site-specific considerations. J-bolts shall protrude approximately 5 inches from the surface of the foundation.

2.5.2 Contractor shall refer to the detail drawings for additional mounting requirements for the pedestal and requirements for the pedestal base.

2.1 Communications

2.1.1 Pedestal mount shall accept Talk-A-Phone flush mounting emergency phone. Contractor shall provide Emergency Telephone in the Pedestal.

2.2 IP Based Video Surveillance Requirements

2.2.1 Pedestal shall include a mounting bracket above the emergency phone for mounting of a fixed CCTV camera. A 2.81" diameter camera opening is located at a 56.24" height, with a clear polycarbonate impact-resistant cover protecting the camera. Contractor shall provide the camera mounting bracket and camera lens opening in all pedestals.

2.2.2 Mount network video surveillance camera inside pedestal housing above the VOIP Call Station. The tower is furnished with a basic mounting bracket that can be reversed if necessary, to change the height of the bracket in relation to the camera lens opening. The camera shall be mounted to the bracket using a standard tripod mounting threaded fastener. The fastener shall be furnished bushing, nuts and fillers as required to properly align the camera lens with the lens opening and securely fasten the camera to the mounting bracket.

2.2.3 Provide network video surveillance camera in Emergency Pedestal Tower. Camera shall be 2-Megapixel, 50/60 fps @ HD1080p, varifocal IR-corrected i-CS-mount lens, 2.8mm-8.5mm, f1.2, Horizontal Field of View 115°-39°
The pedestal tower locations within the standard copper ethernet distance limitations shall be furnished with OSP-Rated Category-6 UTP cables from the IDF Closet location to the Emergency Pedestal Tower location by the 271000 Contractor.

In pedestal tower locations beyond the standard copper ethernet distance limitations, the pedestal shall be provided with a fiber optic cable by the 271000 Contractor. The 28 23 05 Contractor shall furnish and install a ruggedized Ethernet Switch in the base of the pedestal to make the LAN connections to the VOIP Call Station and the Network Camera. Refer to the project drawings for the pedestal towers provided with fiber optic connections.

The 271000 Contractor shall provide a 4-Strand 50/125um Multimode fiber cable from the MDF/IDF Room to the pedestal tower and terminate the fiber cable in the base of the tower. Coordinate with the 27 10 00 for the installation of the fiber cable and termination location. The fiber cable shall be terminated with “LC” type connectors.

Plug fiber optic cable by 27 10 00 Contractor into Ethernet switch in pedestal for LAN connection to the building MDF/IDF location. Fiber optic cable shall be terminated in the MDF/IDF closet. Coordinate with the District IT Department for fiber ethernet connections in the closet. All ethernet switches and fiber patch cables in the closet shall be furnished by the College District IT Department.

Provide an Unmanaged Ruggedized Ethernet Switch in the base of the tower pedestal. Provide switches with the following requirements;

Fiber Switches: (2) 50/125um Multimode LC fiber optic ports and (4) 10/100 RJ45 POE Ethernet ports with 48VDC power adapter by GarrettCom Model #PES42P-1MLC-48VDC (or Approved equal) in the base of the pedestal tower. Ethernet switch’s operational temperature range shall be from -40°C to +75°C (-40°F to +167°F). The switch shall be installed on the accessory shelf inside the pedestal.

Copper Switches: (6) 10/100 RJ45 POE Ethernet ports with 48VDC power adapter by GarrettCom Model #PES42P-ff-48VDC (or Approved equal) in the base of the pedestal tower. Ethernet switch’s operational temperature range shall be from -40°C to +75°C (-40°F to +167°F). The switch shall be installed on the accessory shelf inside the pedestal.

Provide (2) Category-6 patch cables from the ruggedized Ethernet Switch to the VOIP Call Station panel and to the Network Camera inside the pedestal. The switch shall furnish the POE power to the devices.

Pedestal shall include a metal arm mounted to and extending 60" over the top of the pedestal for mounting of a future PTZ dome camera. The LED blue light shall mount to the top of the arm. The LED blue light shall not be enclosed in a
secondary polycarbonate enclosure. A future PTZ dome camera shall mount underneath the arm on a 1.5" NPT. Contractor shall provide the optional camera mounting arm at the top of the pedestal for locations shown on the drawings. The camera mounted at the top of the arm shall be future, but all locations shall be furnished with a primary camera inside the pedestal. The 1.5" NPT camera mounting location on the arm shall be furnished with a threaded cap by the Contractor to close off the mounting arm and prevent the ingress of water, insects or debris.

2.2.8 A custom part number may be required to fulfill the requirements of the project installation. Contractor shall double-check all ordering requirements and part numbers with the manufacturer prior to ordering Emergency Pedestal Towers. The Contractor shall provide the custom part number information and cut sheet at the time of the material submittals.

2.3 Compliance

2.3.1 CSA Certified to UL Standard 60950.

2.4 Warranty

2.4.1 Equipment shall be warrantied against any defects in material and workmanship, under normal use, for a period of five years from date of final acceptance. In the event system is found by manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace any defective parts, provided the equipment is returned to manufacturer.

2.5 Manufacturer

2.5.1 The Manufacturer shall be Talk-A-Phone Co. (773) 539-1100, 7530 N. Natchez Ave, Niles, Illinois 60714-3804, www.talkaphone.com. THERE ARE NO EQUIVALENTS

2.6 The unit shall be an easily identifiable, vandal resistant communications device that is Americans with Disabilities Act (ADA) compliant, multi-functional, freestanding, and constructed of heavy steel. The unit shall be aesthetically pleasing and virtually impervious to damage, and shall include a high quality, vandal resistant, hands-free communications device illuminated by a high intensity faceplate light, a powerful strobe light and a vivid blue beacon that serves to identify the unit from a great distance.

2.7 Tamper resistant fasteners shall be used. It shall not be possible to enter nor remove any component without a specifically designed tool. All other types of fasteners shall not be acceptable under any circumstance.

2.8 The unit shall have an access opening near the base of the unit which provides access for mounting to the anchor bolts and connectivity to electrical facilities. The access opening shall have a cover plate which mounts flush with the unit. This cover plate shall be the same steel and radius as the unit. The cover plate shall fit precisely into the opening and have a weather resistant gasket to prevent water and other elements from entering the unit.

Mounting Requirements

2.9 The unit shall be mounted onto four anchor bolts that are set into concrete as shown on the drawings. Standard ¾" x 24"galvanized steel anchor bolts, nuts and washers will be supplied with the pedestal towers. Contractor shall install pedestal as shown in the detail drawings regardless of materials provided with the unit for mounting. The unit shall mount ½ “above the concrete to allow air flow within the unit.
Electrical Requirements

2.10 All electrical components shall have a modular plug for easy service and replacement. All electrical wiring shall be concealed within the unit and shall not be visible from the outside of the unit.

2.11 All electrical components in the unit shall be equipped with a fuse for protection from transient voltage conditions.

2.12 The unit shall require 5 amperes at 120VAC.

2.13 The installer shall follow all NEC and local electrical codes when installing the unit power systems.

Finishes

2.14 The unit shall be finished with a highly graffiti and UV resistant coating process.

2.15 The polyurethane finish shall be a multi coat system available in 10 standard colors. Final color shall be selected at the time of submittal.

2.16 The primer coat and finish coat shall each have a minimum coverage thickness of 2.0 mils.

Graphics

2.17 The graphics shall be a durable Nikkalite engineering grade reflective vinyl for high visibility and legibility.

2.18 Custom graphics text, length and color shall be available by the manufacturer. Contractor shall confirm the requirements for all graphics and colors prior to ordering with the Mira Costa Contact in charge of the project. Obtain approval, in writing, prior to ordering any of the pedestals. Contractor shall be responsible for replacing the pedestals if confirmation of color and graphics requirements do not meet the standards set by the College.

General Options

2.19 Provide optional overhead camera mount for a PTZ video surveillance camera where shown on the drawings.

2.20 Provide all pedestals with Polycarbonate opening for internal camera mounting. Camera furnished and installed by the 28 23 05 Contractor.

2.21 The Emergency Call Station in the Emergency Pedestal shall be connected to the Industrial Ethernet switch installed in the pedestal by the 28 23 05 Contractor. The Ethernet switch shall provide the interface to the campus LAN.

2.22 Each pedestal shall be equipped with a VOIP communications interface and shall provide direct two-way communications to the Campus Police Department and/or a specific location designated by the College Administration.

PART 3 - EXECUTION

3.1 Frame of pedestal and all circuit wiring requiring grounding shall be grounded to ground system. All loudspeaker circuits and communication circuits shall operate balanced to ground.
3.2 Circuits shall be grounded as recommended by manufacturer or equipment to which they are connected unless otherwise specified.

3.3 All wiring shall test free of grounds and shorts.

3.4 All wiring for the complete system shall be new wire. Any wires pulled through in underground junction boxes shall be continuous with no splices in these boxes. The wiring shall be intact without cuts in the protective outer jacket.

3.5 All data cabling will be provided and installed by the 27 10 00 Contractor. Ethernet switches in the Emergency Pedestals shall be furnished and installed by the 28 23 05 Contractor. Connect the VOIP communications device to the Ethernet switch. Provide all Category-6 UTP patch cables to the Ethernet switch. Coordinate installation with the 27 10 00 and 26 00 00 Contractors.

3.6 All pedestals provided shall be UL listed.

3.7 All materials shall be delivered to the site in unbroken packages. Packages shall be inspected and approved by the District Inspector before opening.

3.8 Contractor shall submit shop drawings to the Project Engineer.

General Performance Requirements

3.9 Reproduction of speech shall be clear, high fidelity, and with all frequencies within range of system faithfully reproduced with no detectable noise, hum, or distortion.

3.10 Audio level of telephone intercommunication system shall be attained at sound levels sufficient to override noise levels typical for schools and traffic areas, to provide a thoroughly satisfactory and serviceable system. The Contractor shall adjust the speaker levels at all locations to provide optimal sound pressure levels and clarity.

Inspection and Test upon Completion

3.11 Check out and final connections to the system shall be made by a factory-trained technician in the employ of a manufacturer of the products installed. In addition, factory-trained technicians shall demonstrate operation of the complete system and each major component to the District.

3.12 System field wiring diagrams shall be provided to the District by the system manufacturer prior to completion of the installation.

3.13 All materials and installation shall be guaranteed to be free of defects in material and workmanship for two years after final acceptance of installation and test.

3.14 Upon completion of the installation, four (4) copies of complete operational instructions shall be furnished, complete with record drawings. Instructions shall include part numbers and names, addresses, and telephone numbers of parts source. Final payment shall not be made until operational and maintenance manuals have been received.

3.15 Upon completion of the installation of the equipment, Contractor shall provide to the District a signed statement from the equipment manufacturer that the system has been tested and functions properly according to the specifications.

Operation and Training
3.16 Three (3) separate inspection site visits shall be conducted by the Contractor, at six (6) month intervals during the warranty period, in order to verify that each system component and the complete system is functioning correctly, beginning six (6) months after final acceptance. The inspection visits shall be conducted during normal school hours and shall be coordinated with the District IT Department and the Campus Police Department. The Campus Police shall provide the Contractor with a list of potential issues or items to be rectified. The Contractor shall be required to test all station functions at each pedestal and reprogram any and/or all stations or functions at any pedestal found to be non-compliant.

3.17 Warranty service calls made by telephone to this Contractor or his designated representative shall hereby be defined as proper notification that warranty service is required.

3.18 A factory representative shall provide one (1) 4-hour training session after final completion of the installation, prior to final acceptance and one (1) 2-hour training session six months after final acceptance of this project. Training shall be provided to the Campus Police Personnel and District IT Personnel designated by the College District. Final acceptance and sign-off of the project will not be granted until the initial 4-hour training session has been completed and verification has been given in writing by the College District Project Manager.

PART 4 – RECORD DRAWINGS

4.1 The contractor shall maintain record drawings as specified in accordance with these specifications, and as noted below.

4.2 Drawings shall show locations of all concealed and exposed conduit runs, giving the number and size of conduit and all cabling. Underground ducts shall be shown with cross section elevations and shall be dimensioned in relation to permanent structures to indicate their exact location. Drawing changes shall not be identified only with referencing CORs and RFIs, the drawings shall reflect all the actual changes made.

4.3 Final As-Built Drawing Submittals - Provide (1) hard bound copy of “E-size” As-Built drawings and (3) copies on USB Flash Drive in AutoCAD (2014 or newer version) format. A Hand marked-up copy of the original construction drawings will not be accepted as the final As-Built drawing submittal. Final As-Builts shall include copies of the floor plan and site plan drawings, detailed elevations of Emergency Pedestal equipment installations, quantities of locations, locations of all interface wallplates, remote equipment and identification of all final cable routes.

END OF SECTION
SECTION 28 30 01
FIRE ALARM VOICE EVACUATION SYSTEM

PART 1 – GENERAL

1.1 Work Included:

1.1.1 Furnish and install all equipment, accessories, and materials in accordance with these specifications and drawings to provide a complete and operating fire alarm system.

1.2 Related Work:

1.2.1 Division 26 01 00: Electrical General Provisions
1.2.2 Division 26 05 33: Conduit and Fittings
1.2.3 Division 26 05 34: Outlet and Junction Boxes

1.3 The equipment and installation shall comply with the current applicable provisions of the following standards:

NFPA 72-2016. ....... National Fire Alarm Code with California Amendments.
CBC - 2016. .......... California Building Code (CBC), Part 2, Title 24, CCR.
CEC - 2016. .......... California Electrical Code, (CEC), Part 3, Title 24, CCR.
CFC - 2016. .......... California Fire Code (CFC), Part 9, Title 24, CCR.

1.4 The system and all components shall be listed by Underwriters Laboratories, Inc. for use in Fire Protective Signaling Systems under the following standards as applicable:

UL 38 ................. Manually Actuated Signaling Boxes.
UL 50 ................. Cabinets and Boxes.
UL 268 ............... Smoke Detectors for Fire Protective Signaling Systems.
UL 268A ............. Smoke Detectors for Duct Applications.
UL 346 ............... Waterflow Indicators for Fire Protective Signaling Systems.
UL 464 ............... Audible Signaling Appliances.
UL 864 ............... Control Units for Fire Protective Signaling Systems.
UL 1481 ............. Power supplies for Fire Protective Signaling Systems.
UL 1971 ............. Visual Signaling Appliances.

1.5 Only Fire Alarm Control Panel Equipment and Peripheral Field Devices have been shown on the Contract Bid Single Line Block Diagram. Specific and complete wiring between Control Equipment and Peripheral Equipment has been deleted for clarity.

1.6 Submittal shall be made in accordance with Division 26 01 00 – Shop Drawings and Submittals. This submittal shall include the following:

1.6.1 Complete bills of quantities, including all materials, components, devices, wiring and equipment required for this work. The bills of quantities shall be tabulated respective of each and every system as specified, and shall contain the following information for each item listed:

1.6.1.1 Quantity of each type of equipment item.
1.6.1.2 Quantities of 10% spare devices as per 1.16.
1.6.1.3 Description of each item.
1.6.1.4 Manufacturer’s Name and Model Number.
1.6.1.5 Manufacturer’s Specification Sheet.
1.6.1.6 Back box type and dimensions per device type.
1.6.1.7 California State Fire Marshall Listing Sheets for all components.
1.6.1.8 Equipment items which have individual components, will require that all component parts be listed individually.
1.6.1.9 Letter indicating the contractor’s intent to comply with Phase II submittal drawings.

1.7 Phase II Submittal shall be provided **within (20) working days** after the approval of the Phase I submittals and prior to any fabrication or field conduit installations. All shop drawings shall be engineered and drawn on a CAD System. Each submission shall include 'D' or 'E' size print copies to match the contract drawings, and one (1) data disk copy with files in an AutoCAD 2000i or 2004 format. Building floor plan CAD files on disk, will be made available via express mail **after the receipt of payment** of $50.00 per building floor plan, or $300.00 minimum which ever is less. Contractor shall make the request for drawings in writing directly to Johnson Consulting Engineers, confirmation of the request and a release form will be forwarded to the contractor to include a signed copy with payment prior to release of files. Detail or riser diagram sheets or any other drawings other than floor or site plans, will not be made available to the contractor.

1.7.1 **Provide complete shop drawings to include the following:**

1.7.1.1 Complete floor plans, at scale of contract documents, showing the locations throughout the project of all devices, panels conduits, wireways, tray, pullboxes, junction boxes, number and type of conductors, and other devices.

1.7.1.2 Point to point wiring diagrams showing wiring from panel terminals to each device.

1.7.1.3 Riser diagram indicating all wiring and circuits.

1.7.1.4 Current State Fire Marshal listing sheets for all components and devices.

1.7.1.5 Provide battery power supply calculations, indicate point of power supply connection, means of disconnect, over-current protection, etc. for each panel.

1.7.1.6 Provide detailed information on conductors to be used-manufacturer, type, size, insulation, etc.

1.7.1.7 Provide voltage drop calculations for all conductor run is from each panel (i.e., main FACP, remotes, power extenders, etc.) for each panel.

1.7.1.8 Provide written sequence of system operation matrix.

1.7.1.9 Provide list of zones. (Every device that is addressable.)

1.7.1.10 Provide detailed drawing for annunciator panel indicating all zones and initiating devices.

1.8 **Common submittal mistakes which will result in submittals being rejected:**

1.8.1 Not including the qualifications of the installing contractor.

1.8.2 Not including all items listed in the above itemized description.
1.8.3 Including catalog cut sheets which have several items on a page, and not clearly identifying by highlighting, underlining or clouding the items to be reviewed, or crossing out the items which are not applicable.

1.8.4 Not including actual manufacturer’s catalog information of proposed products.

1.8.5 Do not include multiple manufacturers for similar products and do not indicate “or approved equal” statements, or “to be determined later” statements. The products being submitted must be the products installed.

1.9 All equipment and material shall be new and unused, and listed by Underwriter’s Laboratories for the specific intended purpose. All control panel components and field peripherals shall be designed for continuous duty without degradation of function or performance. All equipment covered by this specification or noted on Installation. Drawings shall be equipment suited for the application and shall be provided by a single manufacturer or be recognized and UL listed as compatible by both manufacturers.

1.10 It will be the responsibility of the Contractor to ensure proper specification adherence for system operation, final connection, test, turnover, warranty compliance, and after-market service. The distributor of the equipment specified must be factory-trained and certified.

1.11 Basic System Functional Operation, upon operation of any automatic, manual or other initiation device the following shall occur:

1.11.1 The system alarm LED shall flash.

1.11.2 A local piezo electric signal in the control panel shall sound.

1.11.3 A backlit 80-character LCD display shall indicate all information associated with the fire alarm condition, including the alarm point and its location within the protected premises.

1.11.4 History storage equipment shall log the information associated with each new fire alarm control panel condition, along with time and date of occurrence.

1.11.5 All system output programs assigned via control by event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

1.11.6 LED display and audible signaling at the remote annunciator indicating building, fire zone, and type of device. Annunciator shall also provide a separate audible signal for CO detection with a green flashing light, with classroom number indication.

1.11.7 Automatic retransmission to a UL central station for fire department notification.

1.11.8 Automatic shut down of air conditioning units shall be performed by control modules at each unit when required as part of a complete area coverage design scheme. Each building shall shut down all A/C units and dampers within that building as one zone.

1.12 All equipment and components shall be new, and the manufacturer’s current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protective signaling system.
1.13 All equipment and components shall be installed in strict compliance with manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

1.14 All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.

1.15 All wiring shall be installed in a conduit system.

1.16 The contractor shall provide as a part of this contract additional control modules, heat detectors, smoke detectors, CO detector, duct detectors, manual pull stations, strobes, speakers, speaker/strobes exterior speakers devices etc. along with all required programming, to equal 10% of the total quantity of devices shown on the drawings, or a minimum of three (3) for each type, whichever is greater. Installation of 50’ of conduit, boxes and all wiring for each of the devices shall be included, and required locations coordinated with CSFM final approved shop drawings. Any devices not required to be included during construction shall be delivered to the District at the completion of the project. The quantities of these devices shall be listed as a part of the Phase I submittals.

1.17 The installing contractor shall provide a copy of current documentation, indicating that the contractor installing the fire alarm systems or devices and wiring, is certified by Underwriters Laboratories (UL) in its product directories under the listing category “PROTECTIVE SIGNALING SERVICES - LOCAL, AUXILIARY, REMOTE STATION, AND PROPRIETARY.” The contractor shall be certified by the manufacturer to install and program the system. The contractor must also provide complete installation of all wiring and equipment, and software programming. Supervised installation of the wiring, devices and/or any software programming shall not be permitted.

1.17.1 The installing contractor must also be an “authorized dealer” by the equipment manufacturer, and must have completed all required training prior to the bid of this project.

1.17.2 The fire alarm system installation shall be warranted by the manufacturer’s representative.

1.17.3 The Contractor shall have a current California C-10 or C-7 Contractor’s License, and all individuals working on this project shall have passed the Department of Industrial Relations Division of Apprenticeship Standards – “Fire / Life Safety Certification Program.”

1.17.4 The installing contractor shall provide, at the time of submittal, a letter of intent to provide an extended service warranty. This warranty shall extend for a total of three (3) years, starting at the completion, testing, and training of this project. The service warranty shall cover all material and labor to keep operational all system devices installed under this project, and shall include two (2) complete U.L. system’s tests and cleaning of all devices at year two (2) and year three (3) of the warranty. Routine cleaning of devices, other than at the two (2) specified U.L. system’s testing periods, will not be included as a part of this warranty.

1.17.5 The installing contractor shall provide, at the time of submittal, a letter indicating that the installation crew for this project meets the following NICET certifications:

1.17.5.1 25% of the installing field personnel must have completed NICET Level 2 Certification.
1.17.5.2 One of the installing field personnel and/or supervisor must have completed NICET Level 3 Certification.

1.17.5.3 Contractor shop drawings shall be signed by an individual who has completed NICET Level 4 Certification.

1.18 All conduit and standard backboxes will be furnished and installed by the Division 26 Contractor. Specialty boxes will be furnished by the equipment supplier to be installed by the Division 26 Contractor.

1.19 Equipment and materials shall be the standard product of Notifier.

1.20 Alternate equipment as manufactured by any other manufacturer not specifically listed above will not be approved for use on this project.

1.21 D.S.A approved drawings are included as a part of the drawing set.

PART 2 - PRODUCTS

2.1 Main Fire Alarm Control Panel:

2.1.1 Fire alarm control panel shall be Notifier NSF2-3030 and provide Voice Evacuation.

2.1.2 The system shall be controlled and supervised by a microprocessor based monitoring fire alarm control panel. The systems shall be addressable, field configurable, programmable and editable. The system shall continuously scan devices for change of status. Each device shall have its own unique address, but shall also be grouped by building as a separate zone for remote annunciation and alarm report purposes.

2.1.3 The fire alarm control panel shall be housed in a lockable, code gauge steel cabinet with 80 character LCD display, master controller operators panel, indicating lamps, silence switch and reset switch mounted on cabinet front. The fire alarm control panel shall be physically and visually located in the general office for monitoring by staff, and shall sound the “Voice Message” in all zones. Signal duration shall be field programmable and initially set at three minutes. Provide all control modules, synchronous modules, etc., to provide a complete working system per all codes that apply.

2.1.4 The fire alarm control panel shall come with standardized software for on-site customization of the system. The unit shall be capable of providing a 600-event historical log with zone or point selectable alarm verification.

2.1.5 Provide a minimum 100 watts of amplification in each FACP with a minimum of 25% spare capacity.

2.1.6 The unit shall support a minimum of 3000 intelligent addressable points and one output point, SPST contact per zone. Provide the number of modules necessary to control and supervise fire alarm devices as shown on the Drawings, as well as to provide 25% spare capacity.

2.1.7 The unit shall also provide a minimum of (2) class B strobe circuits with additional circuits as indicated on the drawings.

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2.1.8 The fire alarm control panel shall be capable of providing a walk test.

2.2 The power feed for the FACP shall be 3-wire, 120volt, AC, single phase (20A circuit) permanently labeled “FIRE ALARM CONTROL POWER”, terminating at the master fire alarm control and supervisory panel. The label shall be red with 1/4” high white lettering. The source circuit breaker must be provided with a lock-on device.

2.3 In addition to the AC circuit, the panel shall be equipped with a DC battery to activate an audible alarm and pilot light in case of a power failure on the AC circuit.

2.4 The master fire alarm panel shall be equipped with a manual pull lever type, supervised report station.

2.5 With the exception of the manually operated report station required at the master fire alarm panel and large assembly areas, the remainder of the school facility shall be equipped with approved, electronically supervised, automatic fire detection devices, such that every room, space, including concealed spaces, such as the attic spaces above ceilings, etc., is provided with approved coverage.

2.6 TRANSPONDER PANELS shall provide voice evacuation/annunciation with a minimum 100 watts of audio amplification to support 70v speaker devices and a minimum of (2) Class B Strobe NAC circuits and be fiber networked to the system. Provide for 25% additional capacity for amplification in each Transponder panel.

2.7 REMOTE POWER SUPPLIES shall provide a minimum of (4) Class B NAC circuits.

2.8 MANUAL FIRE ALARM STATIONS shall be addressable test-reset lock in order that they may be tested, and so designed that after actual emergency operation, they cannot be restored to normal, except by use of a key. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 100 feet, front or side. Manual stations shall be constructed of die-formed, satin-finished aluminum, with operating directions provided on the cover in depressed red letters. The word FIRE shall appear on each side of the stations in depressed letters, 1/2-inch in size or larger. Stations shall be suitable for semi-flush mounting on a standard single-gang box or switch plate, and shall be provided with a terminal block for connection of fire alarm system wiring. Manual pull stations must comply with CBC sections 11B-309 and 11B-403.

2.9 SPEAKER / STROBE DEVICE shall be of the semi-flush type designed for mounting to a standard 4 11/16” deep electrical back box. Each device shall be provided with a semi-flush accessory plate. Exterior speakers shall be weatherproof. The strobe unit shall have a meantime between failure (MTBF) of 1,000 hours or greater. The strobe section shall have a minimum flash rate of approximately one flash per second, with candela rating as per UL standard 1971. Housing shall be white.

2.9.1 In areas containing two or more audible devices, or three or more visual devices, these devices shall be synchronized, Per NFPA 72, Chapter 18 California Amendments (2016).

2.10 SPEAKERS shall operate at either 25 or 70 VRMS and provide tap setting from 1/8 to 2 watts and provide efficient design for high intelligibility at a minimum wattage across a frequency range of 300 to 8000 HZ and shall be white in color. Speakers shall be ADA, NFPA and ANSI compliant.

2.10.1 Speakers for typical classrooms shall be tapped at ¼ watt with exterior speakers tapped at 2 watts. Other areas such as Theaters, Auditoriums,
Gymnasiums, Team Rooms, Cafeterias, Kitchens and all shop areas shall be tapped at 1/2 watt.

2.10.2 Contractor shall also include (2) additional site visits within the first year to adjust speaker output on a space by space basis as requested by the owner.

2.11 STROBES. The strobe unit shall have a meantime between failure (MTBF) of 1,000 hours or greater. The strobe section shall have a minimum flash rate of approximately one flash per second, with candela rating as per UL standard 1971. Housing shall be white.

2.11.1 In areas containing two or more audible devices, or three or more visual devices, these devices shall be synchronized, per NFPA 72, Chapter 18 California Amendments (2016).

2.11.2 Maximum pulse duration to be 0.20 of a second with an ADAAG 4.28.3(3). Visual alarms maximum duty cycle of 40%.

2.11.3 Capable of providing minimum candela. Intensity as shown on plans (effective strength measured at the source).

2.11.4 The flash rate to be a minimum of 1 Hz and a maximum of 2 Hz per NFPA 18.5.3.1.

2.12 HEAT DETECTOR DEVICES shall be analog addressable, fixed temperature x rate of rise, fixed at 200°F and a 15°F/min rate of rise. In janitor rooms equipped with kilns, devices shall be fixed at 200°F.

2.13 SMOKE DETECTOR DEVICES shall be analog addressable, photo-electric.

2.14 CO – CARBON MONOXIDE detectors shall be provided in all Group E Classrooms and provided with a sounder base to alarm individual classrooms with a 4-pulse temporal pattern as well as transmitting a signal to the staffed remote annunciator.

2.15 DUCT TYPE DETECTORS shall be analog addressable, photo-electric type, provide with remote test switch and auxiliary contacts as required for control of A/C units or smoke dampers.

2.16 DIGITAL ALARM COMMUNICATOR TRANSMITTER. The control panel shall meet the requirements of UL 864 for central station connections, and shall be UL listed for use with the fire alarm control panel. The communicator shall be connected to supervise two telephone lines, all wiring required for this connection shall be provided by the fire alarm contractor Coordinate interface with District monitoring company as required.

2.17 REMOTE ANNUNCIATOR shall be an 80 character backlit, alphanumeric, LCD readout display. The display shall include alarm, supervisory, CO detection and trouble condition LEDs and tone alert. Each condition shall have a dedicated acknowledge push button switch to silence the local tone alert but leaves the LED lights on until all conditions have been restored.

PART 3: EXECUTION

3.1 All wiring shall be (min) #18 AWG copper or as noted on drawings. All underground conductors shall be UL wet location rated for use in wet locations, West Penn “Aquaseal” or equal. There shall be no splices in underground handholes or vaults. A multi-
conductor cable rated for use in wet locations will also be acceptable. It must be labeled “FIRE ALARM” in all pull boxes, using a water-tight labeling system.

3.2 Interior, dry location wiring for low voltage initiating circuits shall be #18 AWG copper, twisted shielded pair minimum, signaling circuits shall be No. 14 AWG minimum, and wiring for 120 volt circuits shall be No. 12 AWG minimum. All wiring shall be color coded, solid copper conductor. Use of power limited cable shall be restricted to controls listed for this purpose. Single conductors shall be type THHN/THWN-2 insulated copper.

3.3 Wire markers shall be provided for each wire connected to equipment. The marker shall be of the taped bank type, of permanent material, and shall be suitable and permanently stamped with the proper identification. The markers shall be attached in a manner that will not permit accidental detachment. Changing of wire colors within circuits shall be unacceptable.

3.4 A terminal cabinet shall be installed in the electric room for the fire alarm systems at each building. All fire alarm wiring shall terminate on UL approved strips in this terminal cabinet. All wiring shall be labeled at each termination strip. Wiring shall be configured such that all end-of-line resistors will be installed at the terminal cabinet.

3.5 Fire Sprinkler Activation detecting System(s) shall each be indicated on a separate zone in the fire alarm control panel.

3.6 Fire Alarm Control Panel and all other equipment shall be mounted with the center of all operable reset buttons, located a maximum of 48” front approach / 54” side approach above floor level.

3.7 Contractor shall provide complete wiring between all equipment.

3.8 The Fire Alarm/Life Safety Installation shall comply fully with all Local, State and National Codes, and the Local Authority Having Jurisdiction (AHJ) DSA.

3.9 The Fire Alarm Control Panel and power supply shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the Panelboard as FIRE ALARM CIRCUIT.

3.10 The Control Panel Cabinet shall be grounded securely to a power system ground conductor. Provide a 1/2-inch conduit and 1#12 grounding conductor to the building electrical service ground bus.

3.11 Conduit shall enter into the Fire Alarm Control Panel back box only at those areas of the back box which have factory conduit knockouts.

3.12 All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; an audible and visual trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

3.13 All cables and wiring shall be listed for Fire Alarm/Life Safety use, and shall be of the type as required by and installed per CEC Article 760.

3.14 Final System Acceptance

3.14.1 Provide an NFPA Certificate of Compliance to DSA and the engineer of record. Complete fire alarm system shall comply with Chapter 14 of NFPA for testing and inspection and be sound-tested for audibility in all spaces requiring voice evacuation. This testing shall be performed in the presence...
of the project electrical engineer. Adjust speaker taps or provide additional speakers as required to provide correct audibility.

3.14.2 The system will be accepted only after a satisfactory test of the entire system has been accomplished by a Factory-Trained Distributor in the presence of a representative of the authority having jurisdiction and the Owner's representative. This contractor shall provide all personnel, ladders and testing equipment to assist the local authority in completing this test. Actuate each device and verify that the system performs as specified.

3.14.3 Intelligibility of the system shall be tested via a walk test with district and school staff with the contractor available to adjust the speaker watt output during the walk.

3.14.4 The Contractor will present a complete set of "as-built" Fire Alarm/Life Safety system drawings, and the factory supplied Operator's Manuals as required by the General Provisions section of this specification.

3.14.5 Once the system has been tested and the certificate of compliance completed, the contract shall not be considered complete until after owner training has been completed. The contractor shall notify in writing their intent to provide the training for the system. This notification shall be given to the Division 21 Contractor, Architect and the Project Engineer a minimum of 2 weeks prior to the scheduled training session. The Division 21 Contractor and/or the architect shall be responsible for notifying the owner to confirm that the appropriate District personnel will be made available for this training session. If the Division 21 Contractor does not receive confirmation that the training session can be performed on the proposed date, then another time shall be provided. The training shall consist of the following:

3.14.5.1 Provide a minimum of one (1) four-to-six -hour training period located at the project site, to instruct District personnel in proper operation of all systems.

3.14.5.2 Provide a minimum of three (3) complete owner operation manuals for the District records.

3.14.5.3 Provide a minimum of two (2) complete as built sets of drawings for the District records.

3.14.5.4 Provide all spare parts as described in part 1 of these specifications

3.14.5.5 Provide written confirmation and proposed scheduled dates for follow up training and 1-year complete system test.

3.15 Follow up Training

3.15.1 Provide as a part of this contract, the follow up instructional training period within six (6) months after the final acceptance of the systems. This training shall include a minimum of one four-to-six-hour training period to instruct District personnel in proper operation of all systems and shall instruct the District technicians how to repair any non-operational parts of the system as required. All defective parts shall be replaced at no cost to the owner.

END OF SECTION
SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protecting existing trees to remain.
2. Removing existing trees, shrubs, groundcovers, plants, grass, A.C. paving concrete curb, gutter and base material, and existing concrete slabs.
3. Clearing and grubbing, removal of existing brush and trees, unless shown to remain.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. The contractor attention is directed to the requirements in Division 1 regarding the preservation of existing trees. The work also includes the removal and disposal of obstacles above and below ground that conflict with the work in this project whether or not such obstructions are as shown on the plans.

C. Related Sections include the following:

1. Division 1 for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and temporary erosion and sedimentation control procedures.
2. Division 1 Section "Field Engineering" for verifying utility locations and for recording field measurements.
3. Division 2 Section "Building Demolition" for demolition of buildings, structures, and site improvements.
4. Division 2 Section "Tree Protection and Trimming" for protecting trees remaining on-site that are affected by site operations.
5. Division 2 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.2 REFERENCED STANDARDS:

A. The editions, specifications and standards referenced herein, published by the following organizations apply to the construction only to the extent specified by the reference.

B. Standard Specifications:


C. Standard Drawings:

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Campus's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Division 1 Section "Project Closeout," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section “Quality Control.”

1.7 PROJECT CONDITIONS

A. The plans show general information only. It shall be the responsibility of the Contractor to examine the site to determine the exact existing conditions and character and extent of the work to be performed and clearing operations required.

B. Existing underground lines shown on the plans are shown from best possible information available and shall be verified prior to start of any work. The Contractor is responsible for locating all underground lines by potholing and/or locator service. The Campus maintains a list of locator firms familiar with the underground conditions.

C. Preserve in operating condition all active utilities traversing or within and about the site. Promptly repair any damage to such utility or work due to work under this contract, to the satisfaction of the Campus's Representative.
D. Existing appurtenances and improvements, which are to remain, shall be protected from damage due to work under this section. Such damaged facilities shall be promptly repaired and/or replaced in kind.

E. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Campus and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

F. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Campus’s property will be obtained by Campus before award of Contract.

1. Do not proceed with work on adjoining property until directed by Campus’s Representative.

G. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Campus’s premises where indicated.

H. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

1.8 BARRICADES AND WORK AREA:

A. Provide barricades and warnings (signs and lighting), and maintenance and supervision thereof, in accordance with applicable Federal and State codes and their respective requirements, or as may be directed from time to time by the Campus Representative. Do not commence site clearing until barricades and warnings are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section “Earthwork.”

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 GENERAL:

A. Clear and grub per Section 0300-1 standard specifications except as modified herein.
3.2 LIMITS:
   A. The limits of clearing, grubbing and demolition shall include all areas of work.

3.3 PREPARATION
   A. Protect and maintain benchmarks and survey control points from disturbance during construction.
   B. Locate and clearly flag trees and vegetation to remain or to be relocated.
   C. Protect existing site improvements to remain from damage during construction.
      1. Restore damaged improvements to their original condition, as acceptable to Campus.

3.4 TEMPORARY EROSION AND SEDIMENTATION CONTROL
   A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
   B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
   C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.5 TREE PROTECTION
   A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
      1. Do not store construction materials, debris, or excavated material within fenced area.
      2. Do not permit vehicles, equipment, or foot traffic within fenced area.
      3. Maintain fenced area free of weeds and trash.
   B. Do not excavate within tree protection zones, unless otherwise indicated.
   C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
      1. Cover exposed roots with burlap and water regularly.
      2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
      3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
      4. Backfill with soil as soon as possible.
   D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Campus’s Representative.
1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Campus’s Representative.

3.6 UTILITIES

A. Existing utility lines shall be removed as indicated on plans. Prior to their removal, all required new re-routing and new connections shall be completed and made operative so that their functions to other existing structures served by them can be continuous and uninterrupted. Abandoned utility lines encountered during construction shall be removed.

B. Campus will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
   1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

C. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Campus will arrange to shut off indicated utilities when requested by Contractor.

D. Existing Utilities: Do not interrupt utilities serving facilities occupied by Campus or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Campus’s Representative not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Campus’s Representative written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities is included in Division 2 Sections covering site utilities.

3.7 USE OF EXPLOSIVES:

A. Use of explosives will not be permitted.

3.8 CLEARING AND GRUBBING

A. The limits of clearing and grubbing shall be the area of new construction

B. Remove all trash, rubbish and all other material not suitable for construction operations.
   1. Remove trees, shrubs, grass, and other vegetation to permit installation of new construction.
   2. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   3. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   4. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
   5. Use only hand methods for grubbing within tree protection zone.
6. Chip removed tree branches and [stockpile in areas approved by [Campus’s Representative] [dispose of off-site].

C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.9 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.10 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.11 DISPOSAL

A. All removed and demolished material, including but not limited to concrete, asphalt concrete, trees, brush, vegetation and trash resulting from the work of this section is the property of the Contractor and shall be promptly removed to a legal disposal area off campus. Asphalt and concrete shall not be used as fill material unless otherwise noted.

1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 31 10 00
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following on-site earthwork:
   1. Preparing subgrades for slabs-on-grade, walks and pavement
   2. Excavating and backfilling for new building
   3. Excavating and backfilling utility trenches.
   4. Excavating and backfilling trenches for buried mechanical and electrical utilities, and pits for buried utility structures.

B. This Work does not include earthwork for public improvements which shall be performed in accordance with the Standard Specifications for Public Works Construction (SSPWC) and governing City ordinances.

1.2 RELATED DOCUMENTS

A. Refer to Section 02 32 00 “Geotechnical Investigation”. This investigation is hereby referenced as information for work of this Section. The Owner, Architect, and Structural and Civil Engineers assume no responsibility for conclusions Contractor may draw from information provided. Contract Documents take precedence over recommendations that may be contained in the investigation, and Contractor must obtain approval for deviations from Contract Documents.

B. Refer to other related Sections in Divisions 01, 02, 03, 31, 32 and 33.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subgrade or subbase course and pavement.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations.
   1. Remedial Excavation: Over excavation beneath building pads, retaining walls, paving and flatwork as described in this section and as recommended by the Geotechnical Engineer.
   2. Additional Excavation: Excavation below subgrade or limits of remedial grading elevations as directed by Architect. Any additional excavation and replacement material will be paid for according to the Contract provisions.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. for
footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 lbf; measured according to SAE J-1179.

2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000-lbf breakout force; measured according to SAE J-732.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Layer placed between the subgrade and base course.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 QUALITY ASSURANCE

A. Geotechnical Testing Agency: Soil and material testing for subgrade, base, and paving materials from an independent testing agency shall be certified and shall be the responsibility of the Owner (District).

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving adjacent neighborhood facilities unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than five days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Owner’s written permission.

3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL AND GRANULAR MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. Coordinate soil materials with geotechnical engineer’s written recommendations.

B. Satisfactory Soils: All imported or engineered fill placed at the site shall meet the criteria listed below:

1. Imported Soils shall be approved by Owner’s Geotechnical Engineer prior to import. At least 72 hours (excluding weekends and legal holidays) shall be allowed for sampling and testing of import soils.

2. An Expansion Index (EI) less than 30 and Plasticity Index less than 25.

3. Import soils, where used as wall and trench backfills and if considered to cap the building and improvement surfaces, shall be good quality sandy granular non-corrosive deposits(SM/SW) with very low expansion potential (100% passing 1-inch
sieve, more than 50% passing #4 sieve and less than 18% passing #200 sieve with expansion index less than 20). Import soils shall be observed, sampled and tested as necessary, and approved by the project geotechnical engineer prior to delivery to the site.

4. Fill soils shall not contain deleterious matter, organic material, debris or rocks/ cementations larger than 6 inches in maximum dimension. Organic material (such as roots greater than one inch in diameter) and other debris shall be removed and not incorporated into structural fill.

C. Excavated soils may be suitable for reuse as compacted fill. However, excessive debris in undocumented fill may preclude reusing these materials as a fill source. The Geotechnical Engineer shall approve all reuse of excavated soils. Any soils encountered that do not meet the above requirements shall be exported from the site.

D. Backfill and Fill: Satisfactory soil materials as specified above. Plastic clayey soils are not considered suitable for wall and trench backfills, and good quality sandy granular (D.G.) import soils shall be considered for this purpose.

E. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve. Pea gravel bedding shall be 3/8 inch.

F. Fine-Graded Granular Material: This may be used below concrete slab vapor retarder. Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch (9.5-mm) sieve, 10 to 30 percent passing a No. 100 (0.15-mm) sieve, and at least 5 percent passing No. 200 (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates. Note: This may be indicated on Drawings as “3/8 inch rock or gravel” placed under the floor slab vapor barrier.

G. Sand: ASTM C 33/C 33M; fine aggregate. Clean and free of organic impurities. SE 30 or greater.

H. The existing asphalt concrete (AC) paving planned for demolition may be also pulverized or ground up to smaller than 1-1/2 inches and reused as a subbase layer under the new asphalt pavement crushed aggregate base (AB) layer.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION
A. Prior to commencing earthwork, existing structures, abandoned utilities and improvements, vegetation, and other debris shall be removed and properly disposed off site in accordance with Section 31 10 00 “Site Clearing.”

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. A pre-construction conference with the owner, architect, contractor, civil engineer, soils engineering, and testing firm shall be held at the site prior to the beginning of grading operations to discuss special soil handling requirements.

3.2 DEWATERING

A. Prevent surface water, storm water, and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   2. If necessary, install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
   3. The Contractor shall be responsible for obtaining necessary permits for dewatering and for any necessary treatment of effluent.

3.3 EXCAVATION, GENERAL

A. Site existing fills, surficial soil mantle and upper weathered exposures of the underlying Terrace Deposits shall be stripped (removed) to the underlying dense and competent Terrace Deposits as a part of the project remedial grading operations, and placed back as properly compacted fills.

B. Potentially expansive bearing and subgrade soils will require special mitigation design per Section 1808.6 of California Building Code (CBC).

C. All site excavations, grading, earthwork, construction, and bearing/subgrade soil preparations shall be completed in accordance with Chapter 18 (Soils and Foundations) and Appendix “J” (Grading) of the 2016 California Building Code (CBC), and all applicable codes and ordinances.

D. Excavate for building, structures and pavements to depths as indicated on Civil Drawings. This is the base bid depth. Excavations less than or greater than those indicated, as directed by Owner or his authorized representative (Geotechnical Engineer), shall be made in accordance with Unit Prices established per Section 01 22 00 and the Owner-Contractor Agreement.

E. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
   1. Unclassified Excavation includes the excavation to subgrade of all pavements, structures, landscaping, and the excavation and removal of unsatisfactory materials as identified in the geotechnical investigation.
2. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.1 feet. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Undocumented fill, alluvium or other soft or loose materials shall be removed to competent materials approved by the Geotechnical Engineer or field designate and replaced with properly compacted fill.

C. Actual stripping depths are expected to vary throughout the project site and shall be established in the field by the project geotechnical consultant or his designated field representative.

D. Arrange for Owner's Geotechnical Engineer to observe the foundation excavations prior to forming or placing reinforcing steel.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Undocumented fill, alluvium or other soft or loose materials shall be removed to competent materials approved by the Geotechnical Engineer or field designate and replaced with properly compacted fill.

B. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: 12 inches on each side of pipe or conduit.
   2. Clearance: As indicated.

C. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
   1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for the bedding course.

3.7 APPROVAL OF SUBGRADE

A. Notify Owner's Testing Agency when excavations have reached required subgrade.

B. If Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
   1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
D. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Testing Agency.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Architect.
   1. Fill unauthorized excavations under other construction or utility pipe as directed by Owner or his Geotechnical Consultant.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of any remaining trees.

3.10 FILL AND BACKFILL

A. New fills and backfills shall be adequately processed, thoroughly mixed, moisture conditioned to approximately 3% to 5% above the optimum moisture levels, or as directed in the field, placed in thin (6 inches maximum) uniform horizontal lifts and mechanically compacted with heavy construction equipment to a minimum of 90% of the corresponding laboratory maximum dry density per ASTM D1557, unless otherwise specified. Sandy granular import soils, where used, shall be moisture conditioned to approximately 2% above the optimum moisture levels and compacted as specified. The upper 12 inches of subgrade soils (including trench backfills) under the asphalt concrete pavement base layers shall be compacted to minimum 95% compaction levels.

B. The slab subgrade and foundation bearing soils shall not be allowed to dry prior to pouring the concrete, or additional ground preparations, moisture re-conditioning and pre-saturation will be necessary as directed in the field. The required moisture content of the bearing soils is approximately 3% to 5% over the optimum moisture content to the depth of 30 inches below slab subgrade. Attempts shall be made to maintain as-graded moisture content in order to preclude the need for pre-saturation of the subgrade and bearing soils.

3.11 UTILITY TRENCH BACKFILL

A. Place and compact 6 inch bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
   1. Provide pea gravel bedding for sanitary and storm sewer piping.
   2. Sand bedding may be used for other than sanitary and storm sewer piping.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings; with concrete to elevation of bottom of footings.

D. Place and compact initial backfill of pea gravel, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.
F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final subgrade.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact soils as specified. Owner’s Geotechnical Engineer shall observe all earthwork operations and test the compacted soils.

3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill material on surfaces that are muddy.
   2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that is too wet to compact to the specified dry unit weight.

3.14 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Building Pad (Building Envelope plus 5 feet outside of it): Compact soil to at least 90 percent of the maximum dry density determined in general accordance with ASTM D1557.

D. Pavement (Concrete and Asphalt) Subgrade: The top 12 inches of subgrade shall be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. All soft or yielding soils shall be removed and replaced with compacted fill. Aggregate base and asphalt concrete shall be compacted to at least 95% relative compaction.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 0.1 feet.
   2. Walks: Plus or minus 0.1 feet.
3. Pavements: Plus or minus 0.05 feet.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to observe and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Do not backfill utility trenches until the as-built location and elevation of each utility is surveyed and recorded and until the utility lines have been inspected and satisfactorily tested.

D. Footing Subgrade: Foundation bearing soils shall be observed by the Geotechnical Consultant prior to placing concrete.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 50 feet or less of wall length, but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 50 feet or less of trench length, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project warranty period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner’s property.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   2. Bait-station system.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
   2. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of termite control product.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
   1. Date and time of application.
   2. Moisture content of soil before application.
   3. Termiticide brand name and manufacturer.
   4. Quantity of undiluted termiticide used.
   5. Dilutions, methods, volumes used, and rates of application.
   6. Areas of application.
   7. Water source for application.

D. Bait-Station System Installation Report: After installation of bait-station system is completed, submit report for Owner's records and include the following:
   1. Location of areas and sites conducive to termite feeding and activity.
   2. Plan drawing showing number and locations of bait stations.
   3. Dated report for each monitoring and inspection occurrence, indicating level of termite activity, procedure, and treatment applied before time of Substantial Completion.
   4. Termiticide brand name and manufacturer.
   5. Quantities of termiticide and nontoxic termite bait used.
   6. Schedule of inspections for one year from date of Substantial Completion.

E. Sample Warranties: For special warranties.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products.

1.7 FIELD CONDITIONS

A. Soil Treatment:
   1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
   2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
   1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from a single source and from a single manufacturer.

2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. BASF Corporation.
      b. Bayer Environmental Science.
      c. Ensystex, Inc.
      d. Syngenta.
   2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than three years against infestation of subterranean termites.

2.3 BAIT-STATION SYSTEM

A. Description: EPA-Registered system acceptable to authorities having jurisdiction. Provide bait stations based on the dimensions of building perimeter indicated on Drawings, according to product's EPA-Registered Label and manufacturer's written instructions.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. BASF Corporation.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
   1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
   1. Slab-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
   2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footer and piers; and along the entire outside perimeter, from grade to bottom of footing.
   3. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 INSTALLING BAIT-STATION SYSTEM

A. Bait-Station System: Install during construction to determine areas of termite activity and after construction, including landscaping, is completed.

B. Place bait stations according to product's EPA-Registered Label and manufacturer's written instructions, in the following locations, as directed by Architect:
   1. Conducive sites and locations indicated on Drawings.
2. In and around infested trees and stumps.
3. In mulch beds.
4. Where wood directly contacts soil.
5. Areas of high soil moisture.
7. Each area where roof drainage system, including downspouts and scuppers, drains to soil.
8. Along driplines of roof overhangs without gutters.
9. Where condensate lines from mechanical equipment drip or drain to soil.
10. At plumbing penetrations through ground-supported slabs.
11. Other sites and locations as determined by licensed Installer.

C. Spacing: Place bait stations according to manufacturer's written instructions and at a frequency no less than the following:
   1. One bait station per 30 linear feet of perimeter building wall.

3.5 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.6 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include nine months’ full maintenance by skilled employees of termite-control-treatment Installer. Include monthly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Continuing Maintenance Proposal: This may be required for a warranty. Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
   1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION
SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

   A. Section Includes:

      1. Hot-mix asphalt paving.
      2. Hot-mix asphalt paving overlay.
      3. Hot-mix asphalt patching.
      4. Asphalt surface treatments.

         a. Seal coats.
         b. Crack sealants.

      5. Pavement-marking paint.

   B. Related Sections:

      1. Section 312000 – Earth Moving.

1.3 SYSTEM DESCRIPTION

   A. Provide hot-mix asphalt pavement according to the materials, workmanship, and other applicable requirements of the standard specifications of the State or of authorities having jurisdiction.

      3. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 DEFINITION

   A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.5 SUBMITTALS

   A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

      1. Job-Mix Designs: For each job mix proposed for the Work. Provide certification, by authorities having jurisdiction, of approval of each job
mix proposed for the Work.

B. Material Certificates: For each paving material, signed by manufacturer certifying that each material complies with requirements.

C. Material Test Reports: For each paving material.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of California Department of Transportation (CalTrans) for asphalt paving work.

1. Comply with requirements of local jurisdictions where more stringent than CalTrans requirements.
2. Measurement and payment provisions and safety program submittals included in CalTrans standard specifications do not apply to this Section.

B. Regulatory Requirements: Comply to applicable standards of the San Diego County Air Pollution Control District for quantities of volatile organic compounds (VOC) used in all materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Seal Coat: Comply with weather limitations of ASTM D 3910
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

1. 40 deg F for oil-based materials.
PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Base Coarse Aggregate: Class 2 Aggregate Base mineral aggregate, 3/4 inch maximum size, as specified in CalTrans Standard Specifications.
   1. Recycled asphalt paving may be used as base course aggregate, subject to complying with CalTrans Standard Specifications.

C. Asphalt Aggregate: Type B Aggregate, as specified in CalTrans Standard Specifications.
   1. 3/4 inch maximum size for base course.
   2. 1/2 inch maximum size for surface course.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: Steam Refined, penetration-graded material. AR-8000 or AR-4000 conforming to CalTrans Standard Specifications.

B. Prime Coat: Asphalt emulsion prime coat complying with CalTrans.

C. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Seal Coat: Emulsified asphalt with a minimum 2% - 3% latex or copolymer added with 2-4 lbs of grade #30 silica sand added per gallon and mechanically agitated.

E. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the Environmental Protection Agency (EPA). Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

E. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II.

1. Color: As indicated.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AASHTO "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

2. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure that any air handling system that is likely to ingest fumes is protected and that windows near paving operations are closed.

B. Verify that subgrade is dry and in suitable condition to begin paving.

C. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Notify Architect in writing of any unsatisfactory conditions. Proceed with paving only after unsatisfactory conditions have been corrected.

E. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Repair or replace curbs, manholes, and other construction damaged during cold milling.
2. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
3. Keep milled pavement surface free of loose material and dust.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions, and in compliance with the District Pest Control specifications where more stringent. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure for 72 hours minimum.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 PAVING GEOTEXTILE INSTALLATION

A. Apply asphalt binder/cement, consisting of solvent-free emulsified asphalt, uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd.

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.
3.5 BASE COURSE

A. Install paving geotextile on prepared subgrade or subbase according to manufacturer's written instructions, overlapping sides and ends.

B. Place base course on separation fabric according to manufacturer's written instructions and as follows:
   1. Compact base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
   2. Shape base to required crown elevations and cross-slope grades.
   3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
   4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches or less than 3 inches thick when compacted.

3.6 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. When thickness of asphalt course is 4 inches or less, place materials in a single layer.
   2. When thickness of asphalt course exceeds 4 inches, place material in equal layers, with no layer more than 4 inches or less than 2 inches thick when compacted.
   3. Spread mix at minimum temperature of 250 deg F.
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
   5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day’s work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Use a vibratory roller with dynamic force of 93,000 lbs, or weighing 21,000 lbs. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and rerolling to required elevations. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density, using one of the following methods as acceptable to the authority having jurisdiction:

1. Average Density (Marshall Test Method): 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
2. Average Density (Rice Test Method): 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to
specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 ASPHALT SPEED BUMPS

A. Construct asphalt speed bumps over compacted pavement. Apply a light tack coat to compacted pavement unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F.

1. Asphalt Mix: Same as pavement surface-course mix.

B. Place hot-mix asphalt to speed bump cross section as indicated.

3.10 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.11 CRACK REPAIR

A. Remove vegetation and treat with herbicide.

B. Rout cracks in accordance with SHARP H348 and H349.

C. Fill cracks with hot-applied joint sealant. Apply with a wand from a double jacketed melter.

1. Over-fill cracks and squeegee level with pavement.

3.12 SURFACE TREATMENTS

A. Seal Coat: Apply first coat at rate of 0.125 to 0.185 gal./sq. yd. After first coat has dried, apply second coat at rate of 0.100 to 0.185 gal./sq. yd.

1. Seal coating new pavements should be delayed 6-12 months after installation or as recommended by manufacturer.
2. Preparation: All area shall be power-swept, vacuumed and cleared of loose material.
3. Standing water shall be spread out and allowed to dry. Do not apply seal coat to wet or damp surfaces.
4. Oil spots shall be manually scraped and cleaned with a mild detergent. Apply primer over highly saturated petroleum areas.
5. Cover and protect items within paved area that are not to be coated, such as valve boxes, manholes and concrete.

B. Fog Seals: Apply fog seal at manufacturer's recommended rate, but not less than 0.30 gal./sq. yd. to existing asphalt pavement and allow to cure. Apply in multiple coats. With fine sand, lightly dust areas receiving excess fog seal.
   1. Fog coating new pavements should be delayed 12 months after installation or as recommended by manufacturer unless pavement is showing severe raveling.
   2. On extremely rough surfaces, provide sand fill for base application where recommended by manufacturer.

3.13 PAVEMENT MARKING
   A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
   B. Allow paving to age for 30 days before starting pavement marking, unless otherwise acceptable to the paint manufacturer.
   C. Sweep and clean surface to eliminate loose material and dust.
   D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.14 FIELD QUALITY CONTROL
   A. Testing Agency: District will engage a qualified independant testing agency to perform field tests and inspections and to prepare test reports.
   B. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
   C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.15 DISPOSAL
   A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
      1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Cast-In-Place concrete pedestrian paving and sidewalks.
   2. Curbs and gutters.
   3. Concrete stairs, ramps and landings.
   4. Light standard bases, and similar site structures.
   5. Utility concrete pads.
   7. Integral Color concrete.
   8. Thrust Blocks.
   9. Slurry Concrete.

B. Related Sections:
   1. Section 31 23 16 Excavation.

1.02 REFERENCES

C. ACI 301 - Structural Concrete for Buildings.
D. ASTM - American Society for Testing and Materials
   1. ASTM A185 - Steel Welded Wire Reinforcement, Plain, for Concrete
   2. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   3. ASTM C33 - Concrete Aggregates
   4. ASTM C94 - Ready-Mixed Concrete
   5. ASTM C150 - Portland Cement
   6. ASTM C171 - Sheet Materials for Curing Concrete
   7. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
   8. ASTM C618 – Coal Fly Ash and Raw or Calcinated Natural Pozzolan for use as a Mineral Admixture on Concrete
   9. ASTM C920 - Elastomeric Joint Sealants
   10. ASTM C979 - Pigments for Integrally Colored Concrete
   11. ASTM C1107 - Packaged Dry, Hydraulic - Cement Grout (Non-Shrink)
   12. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete, Paving and Structural Construction
E. CBC - 2007 California Building Code and Supplements
   1. CBC-11 – CBC Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing
   2. CBC-17 – CBC Chapter 17, Structural Tests and Special Inspections
   3. CBC-19 – CBC Chapter 19A, Concrete(for DSA)

1.03 **SUBMITTALS**

A. **Placement Schedule for approval:** Provide details or sketches showing location of each placement of concrete Work. Do not deviate from location of expansion joints or scorelines.

B. **Product data on joint filler, sealants, curing compounds and reinforcing.**

C. **Project Record Documents**
   1. Accurately record actual locations of embedded sleeves, utilities and components that are concealed from view.

D. **Submit Certification of experience for Color finisher.**

1.04 **REGULATORY REQUIREMENTS**

A. **Pedestrian walks, plazas and paving shall comply with CBC-11B, Sections 11B-302.1, and 11B-302.3.** Architect has relied on CACRM published by DSA in its interpretation of these regulations.

1.05 **QUALITY ASSURANCE**

A. **Maintain one copy of all records on site.**

B. **Acquire cement and aggregate from same source for all Work.**

C. **Conform to Section 1905A.13, California Building Code, when placing concrete during hot weather.**

D. **Conform to Section 1905A.12, California Building Code, when placing concrete during cold weather. No placement of concrete permitted below 50 degrees Fahrenheit.**

E. **Mock-up**
   1. Install minimum 5 feet by 5 feet mock-up of concrete sidewalk for each surface treatment specified.
   2. Install mock-up one month prior to installation.
   3. Locate as approved by the Architect.
   4. Use identical forming system, sub-grade type, reinforcing, expansion joints, score joints, finishing and edge trim as specified for installation.
   5. Architect approval required.
   6. Mock-up may not be used in final installation.
   7. Remove mock-up materials from site and dispose legally.

**PART 2 - PRODUCTS**

2.01 **CONCRETE MATERIALS**

A. **Cement:** ASTM C150 - Type I - Normal or Type II - Moderate, Portland Cement type, from one manufacturing plant only.

B. **Aggregates:** ASTM C33, single source for all materials. Maximum size aggregate: 1 inch.

C. **Non-Shrink Grout:** ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 4,000 psi in 24 hours and 7,500 psi in 7 days unless otherwise indicated on Drawings; of consistency suitable for application and a 30 minute working time.

D. **Water:** Potable and not detrimental to concrete.
E. Crushed Aggregate Base: As specified in Section 32 12 16.] Crushed rock and rock dust conforming to requirements of Section 200-1.2, SSPWC, with 3/8 inch sieve requirement waived, or Class 2 aggregate base as defined in Section 26, CSS.

2.02 ACCESSORIES

A. Expansion Joints:
2. Joint Devices: Integral extruded polystyrene plastic; 1/2 inch max. thick, with removable top strip exposing sealant trough; JOINT CAPS.
3. Sealant: Polyurethane two-component type, self-leveling, for level surface application, UREXPAN NR-200 or DYNATRED for sloped surfaces, manufactured by Pecora Corp., Harleysville PA, or equal. Color shall be selected by Architect from manufacturer's standard list of colors.
4. Primer: As recommended by sealant manufacturer.
5. Joint Backing: ASTM C1330, Cylindrical, Type C, closed cell, polyethylene backer rod; oversized 30 to 50 percent larger than joint width. Green Rod by Nomaco Inc. or equal.

2.03 CONCRETE MIX

A. Mix and deliver concrete in accordance with Section 1905A, California Building Code. Deliver concrete in transit mixers only. Mix concrete for 10 minutes minimum at a peripheral drum speed of approximately 200 feet per minute. Mix at jobsite minimum 3 minutes. Discharge loads in less than 1-1/2 hours or under 300 revolutions of the drum, whichever comes first, after water is first added.
1. Design Mix:
   a. Conform to Section 1905A.3, 2007 California Building Code for Proportioning on the basis if field experience or trial mixtures method.
   b. Method B, Section 1905A.2.3. CBC 2001
   c. Conform to Section 1905 and Table 19-A-6, UBC.
2. Do not exceed 0.50 water-cement ratio by weight for floor slabs and for other concrete.
4. Required Strength: Minimum 2,500 psi for sitework concrete.

B. Fly ash shall be used at 15% maximum replacement of the Portland cement at a 1:1 replacement ratio by weight. Fly Ash shall meet the requirements of ASTM C 618 with the exception that the Loss on Ignition shall not exceed 1.0 percent. Only Class F material is permitted.

C. Slurry Concrete:
1. Slump: Between 4 inches and 6 inches.
2. Aggregate: 40 percent sand by weight, 60 percent pea gravel, minimum 1/4 inch, maximum 5/8 inch.
4. Sufficient water shall be added to produce a fluid, workable mix that will flow and can be pumped without segregation of aggregate. Material shall be mechanically mixed until the cement and water are thoroughly dispersed.

2.04 REINFORCEMENT

A. Reinforcing Steel: ASTM A615; 60 ksi yield grade; deformed billet steel bars, uncoated finish.
B. Welded Wire Reinforcement: Plain type, ASTM A185; in flat sheets; uncoated finish, 6 x 6 - W4.0 x W4.0 unless otherwise note on drawings.

C. Tie Wire: Annealed steel, minimum 16 gage size.

D. Dowels: ASTM A615; 60 ksi yield grade, plain steel, uncoated finish.

2.05 FORMS
A. Conform to Section 1906A.1 and 1906A.2, California Building Code.

B. Plywood Forms: APA - Medium density overlay, Group 1, Exterior, PS-1, for exposed surfaces. APA Plyform B-B, Class 1, Exterior, PS-1 for unexposed surfaces.
   1. Use flexible or curved forms for curves with a radius 100 feet or less.

C. Lumber: Douglas Fir species, construction grade, Surfaced Lumber, with grade stamp clearly visible for smooth and straight exposed surface.

D. Form Release Agent; commercially formulated form-release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.06 CURING MATERIALS
A. Water: Potable and not detrimental to concrete.

B. Curing Compound for Colored Concrete: ASTM C309, Type1, Class B; Water-base all resin curing compound-clear, by Burke-Edoco, Euclid Chemical Co. or equal. Curing materials and procedures for colored concrete in accordance with coloring material manufacturer's recommendations.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Verify site conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely and will not cause hardship in placing concrete.

3.02 PREPARATION
A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is doweled to existing Work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.03 PLACING CONCRETE (GENERAL)
A. Convey and deposit concrete in accordance with Section 1905A.9 and 1905A.10, California Building Code. Remove loose dirt from excavations.

B. Notify Job Inspector minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and accessories are not disturbed during concrete placement.

D. Ensure sub-base or base materials have been compacted or otherwise treated.
1. Subgrade soils underneath the exterior slabs should be moisture conditioned and compacted to a minimum 90% compaction levels at the time of fine grading and before placing the slab reinforcement in accordance with ASTM D 1557.

2. Unless otherwise specified, subgrades soils should be prepared in accordance with the geotechnical report.

3. Subgrade soils should be tested for proper moisture and specified compaction levels and approved by the project geotechnical consultant prior to concrete placement.

E. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.

F. Place concrete continuously between predetermined expansion joints.
   1. Install expansion joints at vertical concrete walls at 24 feet on center unless noted otherwise on drawings.

G. Do not interrupt successive placement; do not permit cold joints to occur. Avoid segregation of materials. Perform tamping and vibrating so as to produce a dense, smooth application free of rock pockets and voids. Do not use vibrators to move concrete horizontally.

H. Do not allow concrete to fall free from any height which will cause materials to segregate. Maximum height of free fall permitted in any case: 5 feet.

I. Defective Installation: Repair and clean at Contractor's expense all concrete damaged or discolored during construction. Where concrete requires repair before acceptance, the repair shall be made by removing and replacing entire section between joints and not by refinishing the damaged portion.

J. Proper curing of concrete surfaces is the responsibility of the Contractor. Concrete failing to meet specified strength shall be removed and replaced.

3.04 ON-SITE CONCRETE SIDEWALKS, PEDESTRIAN PAVED AREAS AND RAMPS

A. Forms, Wood: Free from warp, with smooth and straight upper edges, surfaced one side, minimum thickness 1-1/2 inches adequate to resist springing or deflection from placing concrete.

B. Forms, Metal: Gage sufficient to provide rigidity and strength equivalent to wood.

C. Reinforcing Steel: #3 bars, place bars at 16 inches on center each way for sidewalks and paved areas and #4 bars for edges per geotechnical report.

D. Provide an minimum 8 inch wide by 8 inch deep thickened edge reinforced with a #4 continuous bar placed near the bottom along the perimeter.

E. Concrete Placement: Dampen subgrade to retain moisture in concrete mix. Tamp and spade to consolidate concrete for entire length of pour. Strike off upper surface to specified grades.

F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4 inch radius. Repeat tooling of edges after applying surface finishes. Eliminate toll mark on concrete surfaces.

G. Isolation Joints: Locate at slabs abutting vertical concrete surfaces and as patterned on drawings. Install vertically, full depth of concrete with preformed joint filler recessed for plastic cap at 1/2 inch depth at top for sealant application.
   1. Monolithic Curb and Gutter: No expansion joints required between gutter and curb face.

H. Expansion Joints: Locate maximum 24 feet centers and as patterned on drawings. Install vertically, full depth of concrete, install preformed joint filler recessed for plastic cap at 1/2 inch depth at top for sealant application.
   1. Monolithic Curb and Gutter: No expansion joints required between gutter and curb face.
I. Contraction/Crack Control Joints: At 10 feet (maximum 12 feet) each way at concrete paved areas, and 5 feet at sidewalks, tool joint with 1/4 inch radius, depth 1/4 the thickness of slab but not less than 1 inch deep. The larger dimension of any panel shall not exceed 125% of small dimension. Joints shall be no wider than 1/8 to 1/4 inches. Saw cut joints, 3/4 inches minimum to 1 inch maximum depth. Refer to drawings for required design patterns.

1. Detectable warning (Truncated Domes) required at curb ramps less than 1:15 (6.7% slope), DSA IR 11B-3.

2. Detectable Warnings (Truncated Domes) required at all Curb Ramps, American with Disabilities Act Standards for Accessibility Design Section 4.7.7.
   a. Set Paver Truncated Dome products in full mortar bed per Section 32 14 13 Unit Pavers and as indicated on drawings.

***OR***
   a. Plastics/Composites: Cast in place plastic tiles per manufacturer’s instructions and in accordance with CBC.
   b. Form bottom edge flush and free of abrupt changes DSA IR 11B-2.

J. Finish:

1. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Section 11B-302 and 11B-403.

2. Screed concrete to required grade, float to a smooth, flat, uniform surface. Edge all headers to 1/4 inch radius. Edge expansion joints to 1/4 inch radius. Steel trowel to hard surface. Refer to Sandblast finish where “Sand” finish is indicated on drawings.

3. Grades less than 5 percent: shall conform to CBC Section 11B-302 and 11B-403. After final troweling, apply a light broom finish transverse to centerline or direction of traffic.

4. Grades exceeding 5 percent: shall conform to CBC Section 11B-302 and 11B-403. After final troweling, apply a medium broom finish transverse to centerline or direction of traffic.

5. Walkway grades in excess of 5 percent shall conform to requirements of Section 11B-302 and 11B-403, California Building Code.

K. Curing: Cure surfaces:

1. Apply liquid curing compound at rate of 200 sf per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units of any kind.

L. Remove expansion joint plastic caps. Prime both sides of joint and apply self-leveling sealant per Section 07 92 00. Provide smooth concave surface.

M. Apply slip resistant finish in accordance with manufacturer's instructions on concrete ramp surfaces with slope in excess of 5 percent and all formed concrete stairs and landings:

1. Float and trowel concrete once and allow to set until surface will support finisher's supports.

2. Uniformly distribute grains over surface at the rate of 50 lbs. per 100 square feet.

3. Imbed grains with a light wood float.

4. Apply a light steel float. Do not trowel excessively. Grains shall remain visible in a uniform pattern.

3.05 LIGHT STANDARD BASES, MISCELLANEOUS SURFACES, UTILITY PADS, AND SIMILAR SITE STRUCTURES.

A. Forms: Suitable material and type, size, shape, quality and strength to insure construction as designed, true to line and sufficiently rigid to resist deflection during placing of concrete. Clean forms of all dirt, mortar and foreign matter before use.
B. Reinforcement: Place accurately and hold in position, using metal chairs, spacers, metal hangers, supporting wires and other devices of sufficient strength to resist crushing under full load. Clean reinforcing steel of mortar, oil, dirt, loose mill scale loose or thick rust and coatings.

C. Coordinate installation of conduits, cast in place items and other inserts.

D. Finish: Grind or sack as required as determined by the Architect to produce a smooth, straight, plumb and acceptable finish without burrs or form marks. For horizontal surfaces: provide float finish.

E. Curing: Cure surfaces:
   1. Apply liquid curing compound at rate of 200 square feet per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units or finish of any kind.

3.06 CURB AND GUTTER, PERIMETER CONCRETE CURBING, MOW STRIPS CONCRETE DRAINAGE STRUCTURES AND SWALES

A. Subgrade Preparation: Subgrade material, base material and compaction requirements as approved by the Geotechnical Engineer.

B. Forms: Single face type required, cut to conform exactly with face batter and radius, sufficiently rigid to resist springing or deflection from concrete placement. Clean forms of all loose dirt, mortar or similar materials and apply a light coating of oil or other suitable material prior to concrete placement.
   1. Slip Forms: Contractor’s option upon approval of the Architect.

C. Reinforcement: Refer to drawings for size and spacing. Interrupt reinforcement at expansion joints.

D. Concrete Placement: Dampen subgrade to retain moisture in concrete mix. Tamp and spade to consolidate concrete to entire length of pour. Strike off upper surface to specified grades. Cut drain pipes to conform to curb batter.

E. Align joints in curbs, gutters, and concrete paving.

F. Expansion Joints: Locate joint filler at maximum 20 foot centers. Trim off excess filler material flush to finish surface. No sealant application required.

G. Control Joints: at 8 feet on center, tooled joints, 1/2 inch radius.

H. Finish: Apply thin layer of mortar of 1 part portland cement to 1-1/2 parts sand to exposed faces. Trowel to a smooth and even finish with a fine hair broom applied parallel with the line of the work. Round all edges to 1/2 inch radius. No Contractor identification permitted.

I. Curing: Cure surfaces:
   1. Apply liquid-curing compound at rate of 200 sf per gallon, using power sprayer equipped with agitator.

3.07 CONCRETE THRUST BLOCKS

A. Refer to drawings for locations.

B. Installed where the irrigation main changes direction as at ells and tees and where the irrigation main terminates. Pressure tests shall not be made for a period of 36 hours following the completion of pouring of the thrust blocks. Concrete thrust blocks for supply mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all thrust created by the maximum internal water pressure.]
3.08 FINISH AT EXPOSED VERTICAL SURFACES

A. Rubbed Finish: Apply the following to smooth-formed finished concrete per ACI 301:

1. Grout-Cleaned Finish (Sack-rubbed finish): Remove fins, rough spots, stains, and hardened mortar by carefully rubbing with a fine abrasive stone to a smooth even surface. Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

2. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface with slow-speed grinder. In a swirling motion, finish surface with a cork float.

A. Sandblast Finish: Light sandblast where plywood or other smooth forms have been used, uniformly sand-blasted with sharp quartz sand under sufficient air pressure. Such surfaces shall be thoroughly washed with clear water after sandblasting.

3.09 SANDBLAST FINISH

A. Sandblasted Exterior Concrete Finish: Per ACI 301, two-step trowel finish to dense, smooth surface, free from trowel marks and other blemishes.

1. Perform sandblasting no sooner than 28 days after placement of each concrete section, ASTM D4259 Standard Practice for Abrading Concrete.

2. Use backup boards to maintain uniform edges and corners.

3. Use abrasive grit of suitable type and graduation to remove surrounding matrix and expose aggregate.
   a. Medium Sand Blast Finish: Make medium cut, 1/16 to 1/8 inches deep.
   b. Light Sand Blast Finish: Make Light cut, 1/32 to 3/32 inches deep.
   c. Provide sample to Architect for approval.

4. Evenly sandblast uncovered areas until concrete aggregate is exposed, to match reviewed sample.

5. Perform sandblasting as continuous operation, utilizing same crew of workers, to maintain consistency.

6. Use same nozzle, nozzle pressure and blasting technique as used for sample panel.

7. Maintain control over abrasive grit and concrete dust. Provide covers and barriers as necessary to prevent dust from soiling and contaminating surrounding areas.

8. Remove all expanded abrasive grit and concrete dust at the end of each work period, and dispose legally and properly off site.

9. Such surfaces shall be thoroughly washed with clear water after sandblasting.

3.10 TOLERANCES

A. Construction tolerances shall not violate dimensions, grades, slopes required by CBC for accessibility requirements. Adjust work accordingly to comply with requirements.

B. Comply with tolerances of ACI 117 and as follows (tolerances may not exceed CBC maximum or minimum):

1. Maximum deviation of 1/8 inch in 10 feet.
2. Elevation: 1/4 inch (6 mm).
3. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
4. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/8 inch (3 mm).
5. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch (25 mm).
6. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).
7. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch (13 mm).
8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).
9. Joint Spacing: 1 inch (24 mm).
10. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
11. Joint Width: Plus 1/8 inch (3 mm), no minus.

END OF SECTION
PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. Requirements of "General Conditions of the Contract" and of Division 1, "General Requirements," apply to work in this Section with same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

A. Furnish materials, labor, transportation, services, and equipment necessary to furnish and install Lithocrete Quarried Stone™ architectural concrete and other decorative paving types, incorporating the patented Lithocrete® process as indicated on Drawings and as specified herein.

B. Lithocrete concrete occurs both inside and outside. It occurs outside at the building entry, and polished inside in the Lobby and Student Gathering Area.

C. Work included in this Section:

1. Installation of architectural concrete paving called Lithocrete® under U.S. Patents # 6,033,146, # 6,016,63, #7,322,772 B2, #7,607,859 B2 and U.S. Trademarks 1,879,329, # 2,358,183, # 2,358,054, 78/901,549 and 77/294,212.

2. Only experienced Architectural Cast-in-place Concrete installers, certified to install Lithocrete Quarried Stone™ are acceptable for this portion of the project. Acceptance of certification will be based on proof of certification, experience and approved samples and mockups to be provided within 30 days after Notice to proceed. If timeframe is exceeded, suitable certification/experience is not provided, or mockups are unacceptable – installer will not be eligible to install project. For certified Lithocrete Quarried Stone™ installers contact Lithocrete® at 800-899-9921.

3. Approved samples, used for design of this project are available at the Architect’s office.

D. Related Work in other Sections:

1. Section 03 35 43 – Polished Concrete Finishing for interior slabs.
2. Section 32 13 13 - Portland Cement Concrete Paving: Adjacent concrete paving.
3. Section 32 80 00 - Irrigation System: Coordination of sleeve installation.
4. Section 32 90 00 - Landscape Planting: Coordination of plant material placement
5. Section 32 13 73 – Concrete Paving Joint Sealants

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Federal, State and local laws and regulations governing this Work are hereby incorporated into and made part of this Section. When this Section calls for certain materials, workmanship, or a level of construction that exceeds the level of Federal, State, or local requirements, provisions of this Section take precedence.

1.4 APPLICABLE STANDARDS

A. Specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The California Building Code, and U.S. Patents # 6,033,146, # 6,016,63, #7,322,772 B2, #7,607,859 B2, and U.S. Trademarks 1,879,329, # 2,358,183, # 2,358,054, 78/901,549 and 77/294,212 referred to in this Spec-

1.5 QUALITY CONTROL

A. Quality control to be maintained by certified & licensed installers of Lithocrete Quarried Stone™ throughout duration of project.

B. Paving Subcontractor Qualifications: Provide evidence to indicate successful experience in providing Lithocrete Quarried Stone™ similar to that specified herein and demonstrate successful experience.

C. As part of the bid submittal the General Contractor shall submit background information/qualifications on his Architectural Cast-in-place Contractor certified for Lithocrete Quarried Stone™ installation. This information shall provide evidence to indicate successful experience in providing concrete work identical to that specified herein. A listing of projects shall be provided and shall be reviewed and approved as comparable projects to the specified work by the Owner or Architect prior to award of bid. Failure to provide this information or the submittal of incomplete or inaccurate information shall give cause to reject the entire bid as non-responsive and incomplete. The submittal shall provide the Owner and Architect with evidence of successful experience in Lithocrete Quarried Stone similar to that specified herein and can demonstrate successful experience through past project documentation and references.

1. Utilize form at the end of this Section.

D. Demonstration of experience: provide a minimum of five (5) projects of installed Lithocrete Quarried Stone architectural cast-in-place concrete totaling at least 25,000 square feet with a reference list of each containing address of installation, contact person and phone number of project’s architect or owner’s representation. Minimum size of each individual installation shall be 2,000 square feet. Provide two (2) color photos, 8” x 10” size, of each installation listed above representing the installation. Photo #1 shall show the approximate size of the installation. Photo #2 shall be taken approximately 2 to 3 feet from the paving service. See submittals portion of this section for additional information.

E. Supervision: On-site superintendent must have a minimum of 5 years experience installing Lithocrete®.

F. Slip Resistance: Provide a finish with a slip resistance of equal or greater than 0.65 when tested by the Owner in accordance with ASTM F 489

1.6 SITE INSPECTION

A. Verify conditions at site that affect work of this Section.

B. Take field measurements as required.

C. Report major discrepancies between Drawings and field dimensions to Owner’s Authorized Representative prior to commencing work.

1.7 SUBMITTALS

A. Product Data: Submit no later than 10 days after contract award a typed list of products specified in this Section.

B. Shop Drawings:

1. Submit shop drawings for reinforcing steel and accessories in accordance with ACI standards.
2. Paving Jointing and Pour Sequence Plan - indicating the following:
   a) Proposed layout of contraction, construction and isolation joints. Clearly delineate the three different joint types.
   b) Layout of paving types as indicated on Drawing Paving Schedule. Give overall dimensions of each paving type.
   c) Concrete pour sequence. Indicated sequence of paving pour installation.

C. Statement of Mix Design: Submit Statement of Mix Design prepared by batch plant servicing Project for each load delivered to Project. Statement of Mix Design to contain following information:
   1. Name, address, and telephone number of batch plant preparing statement of mix design.
   2. Date of mix design.
   3. Project location.
   4. Contractor requesting load delivery.
   5. Mix design number.
   6. Integral color used.
   7. Gradation for sand and aggregate.
   8. Material weights, specific gravity, and absolute volumes.
   9. Basis of testing, i.e. UBC 2605 D4 and Title 24 2604 D4.
  11. PSI rating.
  12. Signature of testing laboratory manager.
  13. Signed stamp from registered Project structural engineer or architect.

D. Submit evidence of installer qualifications for experience, demonstration of square footage installed, number of projects, and contact information to verify experience as indicated in Quality Control section of this specification.

E. Lithocrete® Surface-Seeded Aggregate (extra stock):
   1. One 1-pound sample of each Lithocrete® aggregate specified, including glass aggregate to match Architect’s sample.

E. Washed Concrete Sand (extra stock):
   1. One new 50-pound sealed bag of washed concrete sand similar to type used during installation of Lithocrete®, for maintenance purposes.

1.8 SUBSTITUTIONS

A. None allowed unless approved in writing by Owner’s Authorized Representative.

1.9 TESTING

A. A testing agency will be designated by Owner (District). Testing personnel to meet ASTM E329 requirements.

1.10 MOCK-UPS

A. Prior to construction, provide (1) 4-foot x 4-foot x 4-inch sample of each Lithocrete® and other indicated paving type specified on Drawings. (C1, C2, C3)

B. Ensure that each mock-up contains joint types specified on project, i.e. construction, contraction, and isolation.

C. Locate mock-ups in a conveniently accessible and protected place. Approved mock-ups will be standard for future Lithocrete® installation review.

D. Remove mock-ups from site upon completion of Work and approval by Owner’s Authorized Representative.
1.11 PROJECT CONDITIONS
A. Keep Work area clean, and in a safe and workmanlike condition so that rubbish, waste and debris do not interfere with work of other trades.

1.12 PRODUCT HANDLING
A. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.
B. Keep Lithocrete® aggregate dry at all times prior to installation.

1.13 COORDINATION
A. Notify Owner's Authorized Representative and contractors performing work related to installation of Contractor's Work in ample time, so as to allow sufficient time for them to perform their portion of work.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT
A. Type I, IA, II, IIA, III, IIIA, IV, and V cements, to conform to ASTM C150.
B. Use same brand of cement from single source throughout entire project.
C. Refer to Drawings for cement type specified.

2.2 WASHED CONCRETE SAND
A. Clean, hard, and durable washed concrete sand, conforming to ASTM C33.
B. Use same sand from single source throughout entire project.

2.3 COARSE AGGREGATE
A. Clean, hard, and durable coarse aggregate, conforming to ASTM C33.
B. Use same aggregate from single source throughout entire project.

2.4 LITHOCRETE® SURFACE-SEEDED AGGREGATE
1. Interior sample No.: 18-044L-SD
2. Exterior sample No.: 18-004K-SD
B. Use same Lithocrete® surface-seeded aggregate from same source for each paving type specified throughout entire project.

2.5 MISCELLANEOUS MATERIALS
A. Water: Free from deleterious materials such as oils, acids, and organic matter.
B. Vapor Retarder for Interior Slabs: As specified in Section 03 30 00.

2.6 ADMIXTURES
A. Integral Concrete Coloring Admixture: Refer to Architect’s sample and Drawings for color type & manufacturer.
   1. Acceptable Manufacturers:
      a. L.M. Scofield; (800) 800-9900.
      b. Colorfull by Admixtures, Inc.; (626) 357-3263.
      c. Davis Color (323) 269-7311
      d. Solomon Colors (800) 624-0261
   2. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

B. Air Entrainment Admixtures: Conforming to ASTM C260.
   1. Acceptable Manufacturers:

C. Water Reducing Admixtures: Conforming to ASTM C494, Type A.
   1. Acceptable Manufacturers:

   1. Acceptable Manufacturers:
      b. BASF; Tetraguard (800) 228-3318 or http://www.basf-admixtures.com/en/products/shrinkage_reducing/tetraguard_as20/Pages/default.aspx

2.7 READY MIXED CONCRETE

A. Batched, mixed and transported in accordance with ASTM C94 - "Specifications for Ready Mixed Concrete."

2.8 REINFORCING

A. Reinforcing Steel: Conforming to ASTM A615, clean and free of rust, dirt, grease or oils.

B. Tie Wire: 16-gauge plain cold-drawn steel conforming to ASTM A82, clean and free of rust, dirt, grease or oils.

C. Supports for Reinforcement:
   1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars in place.

D. Polypropylene Fiber Reinforcement: 100% virgin multifilament polypropylene fibers, complying with ASTM C 1116 - Type III.
   1. Acceptable Manufacturers:
      b. Grace Construction Products; MicroFiber™ (800)433-0020 or www.graceconstruction.com/concrete/fibers.html
   2. Application Rate: 1/2 lb. /cy of mix.
2.10 CONSTRUCTION JOINT DOWELS

A. Construct Diamond Dowel Construction Joints or Dowel Basket Joints at modules no larger than 20'-0" x 20'-0".

B. Dowel schedule to match rebar schedule at a minimum spacing of 24-30" o.c.

C. ¼-inch-thick diamond shaped load plate, free of dirt, grease, and oils. Contact PNA Construction Technologies at (800)542-0214 or http://www.pna-inc.com/products/square_dowel_basket/ or contact local suppliers such as White Cap.

2.11 FLY ASH

A. ASTM C618 - Type F.

PART 3 - EXECUTION

3.1 SUBGRADE

A. Subgrade to meet requirements of Section 31 20 00 “Earth Moving.”

B. Ensure that a minimum 2-inch layer of graded washed concrete sand compacted to 95 percent relative compaction is placed over subgrade prior to placing concrete, unless otherwise approved by Architect.

C. Screed sand to a smooth plane.

D. Ensure that utilities, including irrigation lines are buried and compacted below bottom of sand layer.

E. Keep sand damp prior to placing concrete.

3.2 FORMING

A. Be responsible for design and engineering of formwork as well as its construction.

B. Ensure that Work conforms to recommended practice for concrete formwork (ACI 347), latest edition.

C. Do not exceed 20-feet by 20-feet in a formed construction area.

D. Ensure that form lumber is new #2 or better grade wood. Do not use used form lumber.

E. Perform form layout with a digital electronic transit for line layout accuracy.

F. Allow forms to remain in place long enough to allow concrete to set properly. Remove forms when appropriate.

3.3 DESIGN OF MIXES AND PROPORTIONING

A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength in accordance with current edition of ACI Manual of Concrete Practice and PCA "Design and Control of Concrete Mixtures."

B. Concrete mixtures to be designed by an approved commercial testing laboratory, using approved materials to obtain specified minimum compressive strength.

C. Concrete Mix Criteria:
1. Slump: minimum of 4 inch, max 5-inch, with a 1/2-inch slump differential between successive batches. Obtain approval from Owner’s Authorized Representative if slump is outside these parameters.

2. Minimum PSI Rating at 28 days: 3,000.

3. Cement quantity per yard of mix:
   b. Maximum: 7 sacks.

4. Water/cement ratio: 0.55 – 0.65.

5. Sand: 50% of total mix.

6. Coarse aggregates to be a blend of 1” to 3/8”.

7. Admixtures:
   a. Air entrainment: Per local standards
   b. Shrinkage Reducing: Do not exceed 2% by weight of cement.
   c. Integral Color Admix: Per manufacturer to match approved sample.

8. Fly ash: ASTM C618 – Type F.

9. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.

10. Concrete Delivery: Use of concrete loads exceeding 90 minutes from time of batch plant must be approved by Owner’s Authorized Representative.

11. Ensure that batch plant guarantees single source supply for cement, sand, and aggregate for the entire project.

D. Custom Architectural Cast-in-Place Concrete sample mixes are based on custom samples held in the Architect’s office. The custom mix designs involve different Architectural Cast-in-place Lithocrete finishes as indicated in Drawings, involving custom color integral color concrete additives, different glass and rock aggregates seeded into the mix and honed finishes. Exact match to these referee samples and to the specified mockup is required.

3.4 LITHOCRETE® SURFACE-SEEDED AGGREGATE INSTALLATION

A. Lithocrete® is a patented paving process. Installation of Lithocrete® Quarried Stone must be performed by a licensed Lithocrete® installer only.

B. For certified Lithocrete Quarried Stone installers, contact Lithocrete® at 800-899-9921.

C. Lithocrete® Quarried Stone process incorporates use of following products:
   1. Lithocrete® Conditioner™.
   2. Lithocrete® Etch Retarder®.
   3. Lithoseal™ paving sealer.

3.5 BROOM FINISH (C1)

A. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture. Match approved mockup.

B. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic. Match approved mockup.

3.6 SAND FINISH (C2)

A. Finish for "plain" concrete paving that includes a light washing and brushing after the concrete is troweled, to remove the surface paste and lightly expose the fine aggregate, resulting in a surface finish resembling medium grit sandpaper. Match approved mockup. As an option, Contractor may use sweep blasting to cured concrete only when approved by Architect.
3.6 JOINTING

A. Refer to ACI 302 “Guide for Concrete Floor and Slab Construction” for work under this section.

B. Construction and Contraction Joints:
   1. Saw-cut construction and contraction joints in locations indicated on Drawings.
   2. Perform jointing with a new diamond tip circular saw.
   6. Saw-cut joints in a straight line with no over-cutting.
   7. Use a hand tool to saw-cut up to vertical edges such as walls, steps, curbs and columns. No cutting into vertical surfaces will be allowed.

C. Isolation Joint Caulking:
   1. Install isolation joint caulking to be installed under Section 07900 – Joint Sealers.

3.7 CURING

A. After Lithocrete is placed, cure concrete for a minimum of seven (7) days without foot traffic and a minimum of thirty (30) days without vehicular traffic. Contractor shall verify these suggested time frames and shall coordinate this schedule with other related construction.

3.8 SEALING

A. Seal surface of paving using Lithocrete® Sealer. The application of hydrolyzed alkali silica solution inhibits the chemical reaction and resulting derogation inherent with seeding glass or organic materials such as sea shells and metals into concrete.

B. Follow Lithocrete® Sealer directions when applying this product (sealer must be applied in 3 to 6 coats).
REQUIRED ARCHITECTURAL CAST-IN-PLACE CONCRETE SUB-CONSULTANT INFORMATION

The proper installation of specialty concrete finishes such as Lithocrete is critical to the success of the project. The bidder, or the bidder’s subcontractor, shall have five (5) or more LQS™ projects installed. Minimum size of individual installations shall be 2,000 square feet.

I. LICENSED LQS™ INSTALLER
   • Contractor:____________________________________________
   • Project Manager/Foreman:________________________________
   • Phone Number:_________________________________________

II. COMPARABLE PROJECT LIST (PROVIDE MINIMUM OF 5)

1. Project Name: ____________________________________________
   Address:_________________________________________________
   Name of Contact:__________________________________________
   Phone Number:____________________________________________

2. Project Name: ____________________________________________
   Address:_________________________________________________
   Name of Contact:__________________________________________
   Phone Number:____________________________________________

3. Project Name: ____________________________________________
   Address:_________________________________________________
   Name of Contact:__________________________________________
   Phone Number:____________________________________________

4. Project Name: ____________________________________________
   Address:_________________________________________________
   Name of Contact:__________________________________________
   Phone Number:____________________________________________

5. Project Name: ____________________________________________
   Address:_________________________________________________
   Name of Contact:__________________________________________
   Phone Number:____________________________________________

Provide two (2) color photos, 8”x10” in size, of each installation listed above. Photo #1 shall show the approximate size of the installation. Photo #2 shall be taken approximately 2 to 3 feet from the respective paving surface. Photos shall clearly show the detail associated with the LQS™ finish or the photo(s) will be rejected. The bidder must submit the above information along with the color photos with the bid. Failure to submit the information and photos shall be considered a non-responsive bid and therefore the bidder shall be considered non-responsive.

____________________________________________________________
Signature of Bidder                                      Date

END OF SECTION 32 13 16
SECTION 32 13 73
CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Cold-applied joint sealants and Primers for exterior flatwork.
B. Related Requirements:
   1. Section 07 92 00 "Joint Sealants" for sealing joints in locations not specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
B. Product Testing: Test joint sealants using a qualified testing agency.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Pecora Corporation.
      b. W.R. Meadows
      c. Sika
      d. Or approved equal.

B. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.
   1. Manufacturers: Same as above.

2.3 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 1 or 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes wheel stops (also known as parking bumpers).

1.3 PRE-INSTALLATION MEETINGS
   A. Product Data: For each type of product.

1.4 PROJECT CONDITIONS
   A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other
      construction activities.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS
   A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum
      compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered
      corners, transverse drainage slots on underside, and a minimum of three factory-formed or
      drilled vertical holes through wheel stop for anchoring to substrate.
      1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
      2. Mounting Hardware: At each wheel stop provide three galvanized-steel spikes or dowels,
         3/4-inch diameter, minimum length as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that pavement is in suitable condition to begin installation according to manufacturer's
      written instructions.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Install wheel stops in bed of adhesive before anchoring.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Adhesively bond anchors to both wheel stop and pavement.

D. At asphalt paving, extend upper portion of anchor 4-1/2-inches into wheel stop and a minimum of 5-1/2-inches into pavement.

E. Recess head of hardware beneath top of wheel stop. Fill recess with sealant per Section 07 92 00 "Joint Sealants".

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes painted markings applied to asphalt and concrete pavement.
B. Related Requirements:
   1. Section 09 91 13 “Exterior Painting” for painting exterior concrete surfaces other than pavement.

1.3 PRE-INSTALLATION MEETINGS
A. Pre-installation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to marking pavement including, but not limited to, the following:
      a. Pavement aging period before application of pavement markings.
      b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.
      c. Location, Pattern, Wording and Colors of markings to be applied.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include technical data and tested physical and performance properties.
B. Laboratory Test Reports: Architectural Coatings: For primers and paints, documentation indicating the VOC content complying with the limits, testing and product requirements of the San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings."

1.5 QUALITY ASSURANCE
A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of CBC Title 24 for pavement-marking work.
B. Building Code Accessibility Requirements:
   1. Accessible parking spaces serving a particular building or facility shall be located on the shortest accessible route to an entrance complying with CBC Section 11B-208.3.1.

1.6 DELIVERY, STORAGE AND HANDLING
A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer’s labels containing brand name and type of material, date of manufacture, and directions for storage.
B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by the manufacturer. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials and 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dunn-Edwards Corporation.
   2. Sherwin-Williams Company
   3. PPG Paint Corp.
   4. Vista Paint.
   5. Or Equal.

2.2 PAVEMENT MARKING PAINT

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952E, Type II, with drying time of less than three minutes
   1. Colors: As indicated on Drawings.

B. Emissions Limits: Comply with San Diego Air Pollution Control District Rule 67.0.1 "Architectural Coatings".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with the District’s Project Manager.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

3.3 PROTECTING AND CLEANING
A. Protect pavement markings from damage and wear during remainder of construction period.
B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Special Conditions and Division 1 Specifications Section, apply to this Section.

1.2 DESCRIPTION

A. This Section specifies furnishing and installing cast-in-place Detectable/Tactile Warning Surface Tiles set on concrete, where indicated.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s literature describing products, installation procedures and routine maintenance.
B. Samples for Verification Purposes: Submit two (2) tile samples minimum 12” x 12” of the kind proposed for use.
C. Shop drawings are required for products specified showing fabrication details, composite structural system, tile surface profile, sound on cane contact amplification feature, plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.

1.4 QUALITY ASSURANCE

A. Provide Cast in place detectable/tactile warning surface tiles and accessories as produced by a single manufacturer with a minimum of five (5) years experience in the manufacturing of Cast In Place Detectable/Tactile Warning Surface Tiles.
B. Installer’s Qualifications: Engage an experienced Installer certified in writing by Cast in place detectable/tactile warning surface tile manufacturer as qualified for installation, who has successfully completed installations similar in material, design, and extent to that indicated for Project.
C. Americans with Disabilities Act (ADA): Provide Surface Applied Detectable/Tactile Warning Surface Tiles which comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title III Regulations, 28 CFR Part 36 ADA Standards For Accessible Design, Appendix A, Section 4.29.2 Detectable Warnings On Walking Surfaces).
D. Tactile Warning Surfacing shall have a coefficient of friction of 0.6 minimum when tested in accordance with ASTM C 1028.

1.5 DELIVERY, STORAGE AND HANDLING

A. Cast in place detectable/tactile warning surface tiles shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy plastic wrappings to protect tile from concrete residue during installation and tile type shall be identified by part number.
B. Cast in place detectable/tactile warning surface tiles shall be delivered to location at building site for storage prior to installation.

1.6 SITE CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing. Retain "Weather Limitations for Adhesive Application" Paragraph below if using adhesive.

B. Weather Limitations for Adhesive Application:

1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
   a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.7 GUARANTEE

A. Manufacturer’s certification that indicates compliance with the architectural access standards as published in the current edition of the CBC.

B. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering and wear.
   b. Deterioration of durability criteria as listed below.
   c. Separation or delamination of materials and components.

2. Warranty Period: Provide a minimum five-year warranty from date of Substantial Completion of durability criteria, including shape, color fastness, confirmation, sound-on-cane acoustic quality, resilience and attachment.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines for Buildings and Facilities, and the CBC for tactile warning surfaces.
1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and fasteners from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. Detectable warning surfaces shall comply with CBC Section 11B-705.1.

D. Detectable warning surfaces at transit platform edges, bus stops, hazardous vehicular areas, reflecting pools, and track crossings shall be yellow and approximate FS 33538 of Federal Standard 595C. Detectable warning surfaces at other locations shall be either the aforementioned yellow or a color providing 70 percent minimum visual contrast with that of adjacent walking surfaces. The material used to provide the visual contrast shall be an integral part of the surface. CBC Section 11B-705.1.1.3.

E. Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact. Such constraint shall not be required for detectable warning surfaces at curb ramps, islands, or cut-through medians. CBC Section 11B-705.1.1.4.

2.2 DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles with replaceable surface configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   - Armorcast Products Company.
   - Detectable Warning Systems, Inc.
   - StrongGo Industries, LLC.
   - Or Equal.

2. **Material:** Cast-fiber-reinforced polymer concrete tile.

3. **Color:** Safety yellow.
   - Color No. 33538 per Federal Standard 585C.
   - Color must be integral throughout the tile and not surface applied.

4. **Sizes:**
   - Rectangular panel, per Drawings.

5. **Mounting:**
   - Permanently embedded detectable warning tile wet-set into freshly poured concrete.
   - Detectable warning tile set into formed recess in concrete and adhered with mortar.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer’s written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer’s written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated.

C. Provide expansion joints around perimeter of precast concrete tiles and at 8’ on center maximum in both directions.

D. Installation must comply with the architectural access standards as published in the current edition of the CBC.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles:

1. Concrete Paving Installation: Comply with installation requirements in Section 32 13 13 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer’s written requirements for satisfactory embedment of tile.

2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedment in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.

4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.

5. Clean tiles using methods recommended in writing by manufacturer.

3.4 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint. Replace using tactile warning surfacing installation methods acceptable to District Construction Manager.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work: The general extent of the miscellaneous paving surfacing is shown on the Drawings and includes, but is not limited to:

1. Furnishing and installing landscape rock cobble.
2. Furnishing and installing rock for gabion cages.

B. The General and Special Conditions of the contract apply to the work of this section the same as though written herein.

1.2 SCOPE OF WORK

A. Furnish all labor, materials, facilities, transportation and equipment necessary to complete all miscellaneous paving and surfacing and related work as shown on the Drawings and Specifications.

B. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damage, injury, and loss due to his acts or neglect. Contractor shall continuously protect and maintain all areas included in the contract during the progress of the work, through the establishment period, and until final acceptance of the work. Contractor is responsible for all repairs or replacements caused by acts of vandalism, including removal of graffiti, and/or refinishing, as required.

1.3 RELATED SECTIONS

Including, but not limited to the following:

A. Section for – Earthwork
B. Section for - Base Courses
C. Section for - Portland Cement Concrete
D. Section for – Furnishings

1.4 SUBMITTALS

A. Conform to Section 01300.

B. Submit representative samples of the following:
   1. Crushed Rock & Rubble fill for gabion interior core
   2. Decorative River/Beach Cobble fill for gabion exposed face
   3. Rock cobble fill for landscape uses
   4. Metal Edging for landscape areas

1.5 QUALITY ASSURANCE

A. Materials Source: Sources of materials specified herein shall not be changed during course of work without review and written approval of the Architect.

B. Sequencing and Scheduling
C. Coordinate installation of base course material where specified to minimize time delay between the two operations.

D. Coordination installation of gabion materials with the Architect.

E. Layout and coordination of metal edging restraint headers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Crushed Rock & Rubble
1. 1-1/2" minus crushed rock for miscellaneous fill and utility
2. Gray and tan color
3. Imperial Gray or equal as per KRC Rock 700 N Twin Oaks Valley Rd, San Marcos, CA 92069 Contact: Hennesys Hernandez (760) 744-1036

B. Beach/River Cobble
1. 8" minus dia.
2. Gray, Tan colors
3. San Joaquin or equal as per KRC Rock 700 N Twin Oaks Valley Rd, San Marcos, CA 92069 Contact: Hennesys Hernandez (760) 744-1036

C. Rock Cobble
1. 3"-5", 5"-9" minus granitic cobble
2. Tan, gray & russet colors
3. Mexican Sunburst or equal as per Southwest Boulder & Stone 2130 W. Mission Rd., Escondido, CA 92029

D. Metal Edging Restraints
1. Sure-loc ‘SureEdge’ 3/16-gauge aluminum metal edging restraints for heavy duty applications as shown on the drawings. Metal edging to be an interlocking system with 5 staked punch-outs fabricated in each 16' strip length or 3 staked punch-outs for each 8' strip length.
2. Ancillary hardware clips and 18" metal staking for installation per manufacturer guidelines.

PART 3 - EXECUTION

3.1 PREPARATION

A. Make provisions for the installation of assemblies required for installation of paving and surfacing with site furnishings.

3.2 CRUSHED ROCK & RUBBLE

A. Install rock and rubble infill for gabion core.

B. Provide materials management so that core material is covered and obscured from exposed surfaces and sides.

C. Compact and consolidate rubble infill to achieve adequate compaction, settlement and support of Decorative cobble face materials.

3.3 DECORATIVE RIVER/BEACH COBBLE

A. Provide and install rock cobble for gabion bench exposed faces.
B. Provide materials management so that core material is covered and obscured from exposed surfaces and sides. Decorative cobble shall be placed at equal lifts along with gabion core materials.

C. Compact and consolidate decorative cobble to achieve adequate compaction, settlement and support of all gabion material prior to installation of seat cap.

3.4 METAL EDGE RESTRAINT

A. Provide layout of review and approval by College’s Representative prior to final installation and backfill.

B. Sections to lock together without offset or double thickness at the joints and secured with two 18” stakes at every joint, change in direction or at terminal ends of edge restraint.

C. Stakes to be a minimum of 12” long, secured 1/2” below top of edging, and locked into place. Stakes to be placed on in-board side of landscape planter areas.

D. Check all adjacent work by other trades and ensure that all underground lines, irrigation piping, conduits and other similar work are installed below the maximum depth of edging to be used and sufficiently clear of adjacent work.

E. Anchor edge restraint to resist soil heaving of expansion and shrinkage. Include 2 stake-shaped cut outs per 16” section & 1 per 8” section, located at the bottom of the material. Intended to accept a standard sure-loc stake at a 45-degree angle to reduce edging movement and especially soil shifts due to temperature changes.

F. Back fill on both sides of edging during installation, leaving no more than two sections unsupported at one time. Compact back fill along edging ensuring that top edge is no more than 1/2” above finish grade of planter area.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Special Conditions of the contract apply to the work of this section the same as though written herein.

B. Comply with all local and State codes, ordinances, safety orders, and regulations of all legally constituted authorities having jurisdiction over this work.

C. Obtain and pay for all plumbing permits and all inspections required by authorities stated above.

D. Notify the Architect in the event any equipment or methods indicated on the drawings or in specifications conflicts with local codes, prior to installation.

1.2 WORK INCLUDED:

A. The work consists of furnishing labor, tools, machinery, materials, and processes required to complete the sprinkler irrigation system described herein and shown on the drawings.

B. The intent of the drawings and specifications is to indicate and specify a complete sprinkler system, installed ready for use without further cost in labor or material to the Owner.

C. In the event of conflict between the drawings and specifications, the Architect shall be consulted.

1.3 RELATED WORK

A. Section 32 90 00 – Landscaping

1.4 RESPONSIBILITY

A. The Contractor shall be responsible for all work to be performed under this contract. No subcontractor shall relieve the contractor of his liability to complete the work shown on the drawings and indicated in the specifications.

B. The Contractor shall always protect his work from damage and theft and replace all damaged or stolen parts at his expense until the work is accepted in writing by the Owner.

C. The Contractor shall protect the Owner’s property from injury or loss. All damage to existing property (building, utilities, etc.) or planting (trees, shrubs, lawns, or ground covers) caused by the Contractor during his operation or because of the malfunction of installed work during the guarantee period shall be repaired at his expense.

D. The Contractor shall carefully note all finish grades before commencing work. Any finish grade changed during his work shall be restored to the original contours.

E. The Owner shall not be responsible for damage caused by labor or material furnished by the Contractor under this contract, which might have been prevented by the Contractor’s prudence.

F. The Contractor shall cause minimum interference with work persons, materials, equipment of other subcontractors.
1.5 PERFORMANCE REQUIREMENTS

A. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments as necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent water coverage of turf and planting areas indicated on the drawings.

B. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves and specialties, unless otherwise indicated.
   1. Irrigation Main Piping: 200 PSI
   2. Circuit Piping: 150 PSI

1.6 EXAMINATION OF PROJECT DRAWINGS AND SITE

A. Prior to submission of his bid, the Contractor shall examine the site, the complete drawings of the project, and the specifications for same, in addition to the drawings and specifications for the sprinkler irrigation portion of the work.

1.7 SUBMITTALS / APPROVALS

A. The Contractor shall furnish the articles, equipment, materials or processes specified by name in the drawings and specifications. No substitution will be allowed without prior written approval by the Architect.

1. No substitutions will be allowed for the following District Board approved Sole Source items:
   a. Flow Communication: Weathermatic SL-AIRCARDFLOW.
   c. Controllers: Weathermatic SL400 w/ SLM12-12 Zone Module.
   f. Quick Coupling Valves: Rain Bird 44LRC
   g. Valve Boxes: Carson Specification Grade 910, 2200, 1419, and 1730.
   h. Wire Connectors: Spears DS-400 Dri-Splice Prefilled.

B. The Contractor shall submit to the Architect catalog data and full descriptive literature for approval of items different than those specified.

C. Submit shop drawings and specifications for controller enclosure assembly(s), including electrical wiring schematic. Submit shop drawings and specifications for all special assemblies, e.g. booster pump(s), fertilizer injection, controller enclosure, central control system, moisture-sensing equipment, etc., if shown on the drawings.

D. Equipment or materials installed or furnished without the prior approval of the Architect may be rejected and the Contractor required to remove such materials from the site at his own expense.

E. Approval of any item, alternate or substitute, indicates only that the product(s) apparently meet the requirements of the drawings and specifications based on the information or samples submitted.

F. Manufacturer’s warranties shall not relieve the Contractor of his liability under the guarantee. Such warranty shall only supplement the guarantee.

G. The Architect can, at his option, require a manufacturer’s warranty on any product offered for use.
H. Material shall be of the best quality obtainable, of American manufacture, and shall comply strictly with the drawings and specifications. All equipment shall be new and unused prior to installation.

I. Contractor shall provide an irrigation schedule with the following data:
   1. Description of temporary irrigation measures to support existing landscape shown on the drawings to remain or at landscape interface areas along the limit of work.
   2. Shop drawing submittal of bi-weekly watering schedule for a 12-month period for review and approval by the College’s representative.

J. As-built drawings: Refer to Section 3.8 RECORD DRAWINGS.

1.8 EXPERIENCE AND QUALIFICATIONS

A. The Contractor shall employ only Certified Landscape Technicians (CLT’s) with the California Landscape Contractors Association (CLCA), as foremen for all irrigation installation work.

B. Contractor shall submit to the Architect photocopies of current CLT registration for all foremen performing work on this project.

PART 2 - PRODUCTS

2.1 GALVANIZED PIPE AND FITTINGS

A. Galvanized pipe where indicated on the drawings or specified shall be A.S.A. Schedule 40 galvanized mild steel screwed pipe.

B. Galvanized fittings shall be medium galvanized screwed beaded malleable iron. Galvanized couplings may be merchant coupling.

2.2 BRASS PIPE

A. Brass pipe shall be heavy wall type with threads complying to A.S.A. Specifications.

B. Fittings shall be case brass or case bronze threaded joint and shall comply with A.S.A. specifications. Thread on pipe and fittings shall be taper type.

2.3 PLASTIC PIPE AND FITTINGS

A. Plastic pipe shall be extruded from 100% virgin polyvinyl chloride (PVC) Type 1, Grade 11 as manufactured by Lasco Industries, John-Manville, or approved equal.

B. Pressure and non-pressure pipes to be virgin polyvinyl chloride SCH. 80 and/or SCH. 40 with manufacturer's name, trade mark, size, class, type, working pressure and National Sanitation Foundation rating. Pipe to be marked continuously with manufacturer's name, nominal pipe size, schedule or class, PVC type and grade, National Sanitation Foundation approval, Commercial Standards designation, and date of extrusion.

C. All plastic pipes to be extruded of an improved PVC virgin pipe compound in accordance with ASTM D2241 or ASTM D1784.

D. When connection is plastic to metal, female adapters to be hand tightened, plus one turn with a strap wrench. Joint compound to be non-lead base Teflon paste or tape.

E. Plastic fittings shall be PVC 11, IPS, Schedule 40, NSF slip fittings and Schedule 80 threaded fittings as shown in the details as manufactured by Lasco, Western, or approved equal.
F. Solvent-weld glue shall be Lasco #711 Grey Heavy Body or approved equal. All pressure-side pipe shall be primed with Lasco “Purple Primer” solvent before gluing. Fit and glue pipe per manufacturer’s specifications.

G. All threaded nipples shall be standard weight Schedule 80 molded threads. All threaded nipples exposed above grade shall be gray in color. All threaded fittings and nipples to be wrapped with Teflon tape prior to assembly. No liquid tape shall be used.

H. Pipe for sleeving shall be PVC 1220, Schedule 40, sized as indicated on the drawings. Provide pull rope 10 feet longer than sleeve.

I. All above-grade pipe shall be UVR (ultraviolet resistant) Schedule 40 PVC pipe, as manufactured by Pacific Plastics, or approved equal. All above-grade fittings shall be UVR, as manufactured by Spears Manufacturing Company, or approved equal.

2.4 QUICK COUPLING VALVES

A. Quick coupling valves shall be two-piece body designed for working pressure of 150 PSI as indicated in the legend and installed in accordance with detail thereof. Quick coupling valves shall be installed with locking yellow vinyl covers.

B. Quick coupler valve shall be Rain Bird model #44LRC with Snap-Lok pre-assembled PVC swing joint with male brass stabilizer elbow and Snap-Lok collar as manufactured by LASCO Fittings, Inc. Provide two 18” lengths #3 rebar for support. Provide gravel beneath and up to base of coupler.

2.5 AUTOMATIC CONTROLLER(S) AND RELATED EQUIPMENT

A. Controller(s) shall be as indicated on the drawings. Controller(s) shall be installed per manufacturer's specifications and as shown on the drawings.

B. Controller enclosure(s) shall be stainless steel, heavy duty as indicated on the drawings.

C. Controller number(s) and remote-control access number(s) shall be neatly stenciled onto outside of enclosure door in 2” high letters, using paint designed for direct application onto stainless steel.

2.6 REMOTE CONTROL VALVES

A. Remote control valves shall be as indicated on the drawings and installed in accordance with the details thereof.

2.7 SPRINKLER HEADS

A. Sprinkler heads shall be as indicated on the drawings.

B. All sprinklers shall be installed in accordance with details thereof.

2.8 CONTROL WIRE

A. All wire shall be insulated, solid copper conductor of type approved for direct burial. Use color-coded wire for pilot wires, a different color for all valves of each controller, and install per valve manufacturer's specifications and wire chart. Remote control wire to be direct-burial AWG-UF type. Wires to be (black or red only) for control, and white only for common. Common Extra wires shall be black. A color different from all pilot and extra wires shall be used for master valve and flow sensor wires.

B. Sizing of wire shall be in accordance to manufacturer’s recommendations, in no case less than AWG #14 in size.
C. Connections on 24-volt wire shall be made by Spears Manufacturing DS-400 type dri-splice wire connector.

D. Higher voltage line connections or 110 volt shall be made by clamp and waterproofed with 3M Company Scotchcast splicing kits or approved equal.

2.9 VALVE BOXES

A. Remote control valve boxes shall be glass-filled plastic type as manufactured by Old Castle Carson ‘Specification Grade’ series. Box extensions if necessary to facilitate installation shall conform to the same manufacturer’s specification. Boxes shall have locking lids, provide two keys minimum.
1. Rectangular valve boxes for control valves and manifolds: Carson Specification Grade 1419 or 1730.
2. Round valve boxes for quick couplers, shut off valves, or similar: Carson Specification Grade 910 or 2200.

B. Valve box supports shall be as shown on the drawings or conform to 60 mm concrete paver type brick. Minimum of four supports for rectangular boxes and three for round boxes.

C. Control wires shall be tagged with permanent dual sided imprinted tags for all valves with the controller designation and station number. Tags shall conform to ‘Standard’ size Valve Identification Tag as manufactured by T. Christy Enterprises. Tag color to be yellow with black alpha-numeric text unless specified otherwise.

D. Gravel for setting valve boxes shall be 1/2” - 3/4” crushed gravel.

E. Top dressing gravel for inside valve boxes shall be 3/8” crushed drain rock, washed.

2.10 BALL VALVES

A. Ball valves of size, capacity, and manufacturer as indicated on the drawings shall be provided, installed, and located as shown thereof.

B. Each ball valve shall be housed in a round box as manufactured by Old Castle Carson, as per detail.

2.11 CHECK VALVES

A. Swing check valves 2” and smaller: 200-pound W.O.G. bronze construction with replaceable composition, neoprene, or rubber disc meeting or exceeding Federal Specification WW-V-51D, Class A, Type IV.

B. Anti-drain valves: of heavy-duty virgin PVC construction with FIP threaded inlet and outlet. Internal parts shall be stainless steel and neoprene. Anti-drain valves shall be field adjustable against drawout from 5 to 40 feet of head. Anti-drain valve shall be like the Valcon "ADV" or approved equal.

2.12 BACKFLOW PREVENTION UNITS

A. Backflow prevention units shall be of the size and type indicated on the drawings.

B. Wye strainers at backflow prevention units: shall be bronze threaded body with 60 mesh Monel screen and shall be like Bailey #100B or approved equal.

2.13 EXTRA MATERIALS

A. Refer to section 3.6 EQUIPMENT TO BE FURNISHED.
PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection of Existing Conditions

B. Prior to work of this section, carefully inspect previously installed work. Verify all such work is complete to the point where this installation may properly commence.

C. Verify that work of this section may be installed in strict accordance with the original design, all pertinent codes and regulations, and all pertinent portions of the referenced standards.

D. In the event of discrepancy, immediately notify the Architect.

E. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 SITE CONDITIONS / LAYOUT

A. All scaled dimensions are approximate. The Contractor shall check and verify all dimensions on the site prior to proceeding with work under this contract.

B. The Owner shall locate and mark all existing utilities such as power, telephone, domestic water, sewer, and storm drains. Extreme care shall be taken by the Contractor when excavating or working in these areas and coordination and cooperation between the Owner's Representative and the Contractor is required as the work progresses to these areas. Contractor shall give 24-hour notice to Owner's Representative as work progresses to underground utility areas. Contractor shall be responsible for damage to any utilities.

C. Should utilities not located or marked be found during excavation, the Contractor shall promptly notify the Owner and shall discontinue with the work in the area except necessary emergency work repair or prevent damage until instructions are received.

D. Failure to notify the Owner of discovery of such utilities or damage thereto will result in the Contractor being liable for all damage caused to the utilities because of his actions.

E. The Contractor shall, before starting work on the sprinkler system, carefully note all finish grades to satisfy himself that he may proceed with the work, and to restore finish grades to original contours before completion.

F. The installation of all sprinkler materials, including pipe, shall be coordinated with the landscape drawings to avoid interfering with the trees, shrubs, or other plantings.

G. Layout sprinkler heads and make any minor adjustments required due to differences between site and drawings. Any such deviations in layout shall be within the intent of the original drawings, and without additional costs to the Owner. When directed by the Architect, the layout shall be approved before installation.

H. The work shown on Irrigation Plans is schematic. All items, I.E. controllers, valves, mainlines, sleeves, wires, irrigation heads, piping, etc., are shown in their approximate locations only. Do not use these plans to scale dimensions for placement of these items. Detail drawings may provide additional clarification or location of some items. Contractor shall not locate any items where it is obvious that they are in direct conflict with underground utilities, structures, permanent improvements, or pedestrian and vehicular safety considerations. Sprinkler heads are not to be scaled off of the drawings, but located to prevent overspray onto buildings, walks, and structures. Notify the Landscape Architect immediately of any discrepancies between plans and actual field conditions.

I. Do not willfully install the sprinkler system as indicated on the drawings when it is obvious in the field that unknown obstructions or grade differences exist, that might not have been
considered in the engineering. Such obstructions or differences should be brought to the attention of the Architect.

3.3 WATER SUPPLY

A. The Contractor shall connect to the water source as indicated on the drawings. The Contractor shall verify static pressure as stated on the drawings prior to beginning work. If static pressure or point of connection differ from that shown on the drawings, the Contractor will promptly notify Architect before starting work.

3.4 WORKMANSHIP AND PROCEDURE

A. The routing of the pressure supply lines as indicated on the drawing is diagrammatic. The Contractor shall install lines in such a manner as to conform with the various details without offsetting the various assemblies from the pressure supply line.

3.5 INSTALLATION

A. Assemblies
   1. All threaded pipe and fittings shall be assembled using Teflon tape or equivalent, applied to the male threads only.
   2. All assemblies specified herein shall be installed in accordance with their respective detail. In the absence of detail drawings or specifications pertaining to the specific items required to complete the work, the Contractor shall perform such work in accordance with the best standard practice and to the satisfaction of the Owner.

B. Pipe Clearances
   1. All sprinkler lines shall have a minimum clearance of 6" from each other. Parallel lines shall not be installed directly over one another.

C. Excavation, Piping, and Backfilling
   1. Trenches: Pipe shall have the continuous support of the trench bottom and shall be laid to an even grade. Trenching excavation shall follow the layout indicated on the drawings and shall be of enough width to allow "snaking" of pipe in trench.
   2. Provide minimum cover of 24 inches for all pressure supply lines.
   3. Provide minimum cover of 24 inches for all control wire runs.
   4. Provide minimum cover of 18 inches for all non-pressure lines.
   5. All lines under driveway and roadway pavement shall have a 24-inch minimum cover.
   6. Backfill for trenching shall be compact to dry density equal to the adjacent undisturbed soil in planting areas and 90% under paved areas and shall conform to the adjacent grades without dips, sunken areas, humps, or other irregularities. Initial backfill on all lines shall be of a fine granular material with no foreign matter larger than one-half inch in size.
   7. If, in the opinion of the Owner, the excavated material is not satisfactory for use as backfill, the Contractor shall dispose of this unsatisfactory material.
   8. Provide concrete thrust blocks at angles, trees, and bends in mainline runs per drawings.
   9. Reserved.
   10. All pressure-side pipe shall be laid with metallic warning tape 9" directly above the pipe, per details.
   11. Provide two-inch sand bedding and four-inch sand backfill over pipe in paved areas. Provide sleeves for main line under paved areas subject to vehicular traffic.
   12. Trenches shall be backfilled promptly after the open trench inspection.

D. Sleeving
   1. Sleeving shall extend 4’ minimum beyond edge of paving or walkway.
   2. All sleeving shall be laid with metallic warning tape 9” directly above sleeve.
   3. Provide permanent pavement marking pin at both ends of sleeve, standard brass survey pin in lead, set 1’ from edge of paving or walkway.

E. Control Wires
1. Between controllers and remote-control valves, use a continuous wire. Under no circumstance shall splicing exist.
2. Where more than one wire is placed in a trench, the wiring shall be taped together at intervals of ten feet.
3. Wiring shall occupy the same trench and shall be installed along the same route as the pressure supply line wherever possible. Wire bundle shall be placed along the side of mainline pipe. Wire bundles shall not cross over top of mainline.
4. A loop of twelve inches shall be provided at each directional turn in the wire run.
5. Wire shall be laid loosely in trench, not pulled tight. Lay wire so that there is 12 inches of slack for every 100 feet of length.
6. Provide at least one (1) extra spare wire for every three valves being served by the wire run. Extra wires shall be continuous to end of wire run.
7. Provide enough extra wire under valve boxes so that valve can be completely removed from ground and box for servicing without disconnecting wires.

F. Valve Boxes
1. Install valve boxes in accordance with the details thereof.
2. Seal all below-grade openings in valve boxes and around piping to prevent soil from entering the valve box. Suitable materials include geotextile fabric, heavy gauge shrink-wrap plastic, or other flexible material approved by the Architect. Do not use cardboard, duct tape, or other materials that will deteriorate in wet conditions.
3. Keep valve box lids in place during soil preparation to keep soil out. Remove all soil materials which enter the valve box during construction.
4. Install valve boxes so rim is in same plane as adjacent grade. Where valve boxes occur adjacent to walks, curbs, or header board, locate them 6” clear from edge of improvement. Where two or more valve boxes occur together, locate them with 6” clear between and in a straight row. Due to the schematic nature of plans, if questions, confirm actual valve manifold locations with Architect before proceeding with work.

G. Sprinkler Heads
1. Install each type of sprinkler head in accordance with their respective details.
2. Install sprinkler heads 6” away from walkway or paving edge; 12” away from buildings, above ground utility structures, transformers, and other items.
3. Install sprinkler heads 12” away from walls and wood fences.
4. Install sprinkler heads 6” away from chain-link fences.
5. Do not locate sprinkler heads where it is obvious they will spray onto or into utility structures, buildings, signs, controller equipment, or other structures.

H. Pressure Test
1. All pressure lines shall be tested under hydrostatic pressure of 150 PSI, and all non-pressure lines shall be tested under the existing static pressure and both be proven watertight. (Contractor to supply all equipment needed for testing.)
2. Pressure shall be sustained in the lines for not less than two hours. If leaks develop, the joints shall be replaced, and the test repeated until the entire system is proven watertight.
3. Tests shall be observed and approved by the Architect prior to backfill.
4. Upon completion of each phase of the work, the entire system shall be tested and adjusted to meet site requirements.

I. Flushing the System
1. After all valves, sprinkler pipe lateral lines, and risers are in place and connected, flush entire system, one valve at a time, to clear lines of all dirt and debris.
2. Install sprinkler heads, filter screens, and nozzles immediately after flushing operation is completed.

J. Adjusting Of System
1. The Contractor shall flush and adjust all sprinkler heads for best possible performance and to prevent overspray onto walks, roadways, fences, and buildings.
2. If it is determined that adjustments in the irrigation equipment or nozzle changes will provide proper and more adequate coverage, Contractor shall make all necessary
changes, including installation of additional sprinkler heads, or moving sprinkler heads, without additional cost to the Owner, prior to planting.

3. The entire system shall be operating properly before any planting operations commence.

4. Lower raised sprinkler heads in lawn areas within ten days after notification by the Architect.

K. Electrical
1. Contractor shall verify power sources shall be as indicated on the drawings.
2. The Contractor shall be responsible for making 110-volt electrical connections to the automatic controller and wire circuits from remote control valves to controllers. All electrical work shall be in accordance with all local and/or county ordinances. Wire sizes to be as per manufacturer's specifications.

3.6 EQUIPMENT TO BE FURNISHED

A. The Contractor shall provide as part of this contract, two sets of sprinkler wrenches for adjusting, cleaning, or disassembling each type of sprinkler.

B. One (1) quick coupler key with a 1” bronze hose bib, bent nose type, with hand wheel.

C. Two (2) quick coupler locking cover keys.

D. Two each of any special tools required for any other equipment shall also be furnished.

E. Provide two keys for each automatic controller.

F. Three (3) extra sprinkler heads of each specified size and type.

G. Two (2) service manuals and information pages for all equipment used shall be furnished to the Owner. Manuals may be loose leaf and should show drawings or exploded views of equipment and catalog number. Operating instructions for all equipment shall be furnished.

H. The above listed items shall be turned over to the Construction Manager at the final observation walk-through.

3.7 INSPECTION OF WORK

A. Installations and operations must be approved by the Owner's Representative and the Architect.

B. In no event shall the Contractor cover-up or otherwise remove from view any work under this contract without prior approval of the Owner. Any work covered prior to inspection shall be opened to view by the Contractor at his own expense. The Contractor shall request of the Architect an inspection at least two days in advance. Inspection will be required as follows:
   1. Mainline pressure test and trench depth inspections:
      a. Prior to backfill.
      b. Spot check upon backfill completion.
   2. Coverage test upon sprinkler system completion.

3.8 RECORD DRAWINGS

A. The Contractor shall maintain a complete and accurate set of project record drawings. These drawings shall be kept up to date with the daily progress of the work.

B. Contractor shall provide adequate measurements and field notes as directed by the Construction Manager and/or Architect for preparation of accurate "project record" drawings. Show either actual locations or dimensions form two permanent points of reference such as building corners, curbs, sidewalk, intersections, etc. (but not from irrigation equipment) locations of the following:
   1. Connections to existing water sources.
2. Water meters.
3. Routing of main lines.
4. Location of both ends of all sleeves.
5. Control valves.
6. Quick couplers.
8. Gate valves.
10. Controllers.
11. Major drip irrigation components – operational indicators, flush and air relief valves

C. When project is complete, as built information shall be transferred, in ink, onto a set of reproducible sepia mylars of the original irrigation plans of the contract drawings. All information shall be neatly delineated, and all text shall be 1/8” minimum height.

D. The completed and accepted reproducible record drawings shall be delivered to the Owner on or prior to the final inspection.

3.9 CONTROLLER CHARTS

A. Project record drawings shall be prepared by the Contractor before charts are prepared.
B. Provide one controller chart for each controller supplied.
C. The chart shall show the area controlled by automatic controller and shall be the maximum size controller door will allow.
D. The chart is to be reduced drawing of the installed system. However, in the event the controller sequencing is not legible when the drawings is reduced, it shall be enlarged to a size that will be readable when reduced. If controller sequencing has been changed from the original drawings, the new sequencing shall be indicated on the controller chart.
E. Chart shall be blackline print and a different color shall be used to show area of coverage for each valve station.
F. The chart shall be mounted using Velcro, or an approved equal type of comparable quality.
G. When completed and approved, the chart shall be laminated between two pieces of clear plastic, each piece being a minimum 20 mils thick.
H. These charts shall be completed and approved prior to final inspection of the irrigation system.

3.10 CLEAN-UP AND REPAIR

A. Upon completion of the work, make the ground surface level, remove excess materials, rubbish, debris, etc., and remove construction and installation equipment from the premises.
B. Replace and/or repair to the satisfaction of the Architect all existing paving disturbed during the course of this work. New paving shall be the same type, strength, texture, finish, and be equal in every way to the material removed.
C. Contractor will be responsible for all maintenance and repair of entire irrigation system, including vandalism, until final acceptance.

3.11 FINAL INSPECTION

A. The Contractor shall show evidence to the Owner's Representative that the Owner has received all required accessories, charts, record drawings, etc., before final inspection can occur.
B. Notification by the Contractor shall be made in writing to the Owner seven days prior to final inspection. The final inspection of the work shall be made in the presence of the Owner’s Representative at the time the work is completed.

3.12 GUARANTEE

A. The entire sprinkler system shall be guaranteed by the Contractor as to material and workmanship, including settling of backfilled areas and trenches for a period of one year following the date of final acceptance of the work.

B. Should any operational difficulties in connection with the sprinkler system develop within the specified guarantee period, which in the opinion of the Owner may be due to inferior material and/or workmanship, said difficulties shall be immediately corrected by the Contractor to the satisfaction of the Owner, at no additional cost.

3.13 TEMPORARY REPAIRS

A. The Owner reserves the right to make temporary repairs as necessary to keep the sprinkler system equipment in operating condition. The exercise of this right by the Owner shall not relieve the Contractor of his responsibilities under the term of the guarantee as herein specified.

3.14 IRRIGATION CLOSEOUT

A. Deliver to the Architect all certificates of installation/compliance and test reports on the following:
1. Testing of power and energize of control system
2. Copy of backflow preventer certification by Oceanside Water & Utilities Department.
3. Testing of irrigation system performance and static and active PSI
4. Certificate of controller installation, connection to district central control and hardware/software ‘burn-in’
5. All other items related to project closeout shall conform to sections relating to project closeout.

END OF SECTION
SECTION 32 90 00
LANDSCAPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Special Conditions of the contract apply to the work of this section the same as though written herein.

1.2 SCOPE OF WORK

A. Furnish all labor, materials, and equipment to provide, install, and maintain all soil preparation, headers, finish grading, planting, and establishment period as described herein and upon the drawings.

B. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damage, injury, and loss due to his acts or neglect. Contractor shall continuously protect and maintain all areas included in the contract during the progress of the work, through the establishment period, and until final acceptance of the work. Contractor is responsible for all repairs or replacements caused by acts of vandalism, including removal of graffiti, and/or refinishing, as required.

C. Work not included: rough grading and drainage.

D. The Contractor shall employ only Certified Landscape Technicians (CLT’s) registered with the California Landscape Contractors Association (CLCA), as foremen for all planting installation work.

1.3 RELATED WORK

A. Section 32 80 00 - Irrigation System

B. Section 32 18 00 – Landscape and Turf Establishment

1.4 SUBMITTALS, TESTS, AND INSPECTIONS

A. Submit samples and/or descriptive literature and specifications for the following:
   1. Organic soil amendments.
   2. Pre-emergent herbicide(s).
   3. All inorganic soil amendments, fertilizers, and chemicals.
   4. All plant materials: trees, shrubs, sod, and groundcovers.
   5. Organic and inorganic mulch materials.
   6. Hydroseeding materials and seeds.

B. Contractor shall submit to the Construction Manager photocopies of current CLT registration for all foremen performing work on this project.

C. Any sampling, testing, or inspection costs of material are to be done by the Contractor, and copies of inspection certificates, required by law, shall be furnished without additional charge.

D. Submit, to the Construction Manager, original (not photocopied) delivery tickets for all materials delivered to the jobsite. This requirement must be satisfied prior to commencement of the establishment period.

E. All plant material, 15 gallon and larger, shall be approved and tagged at the source prior to delivery. When this is not practical and approved by the Architect, photos shall be submitted for approval. Submit source for all 5 gallon and smaller plant materials. Regardless of which
method is used, final approval of plant material shall occur at the site. Any plant material that is not accepted shall be immediately removed from the site at Contractor’s expense.

PART 2 - PRODUCTS

2.1 BOXED TREES, CONTAINER TREES, AND OTHER PLANT MATERIAL

A. Nomenclature: see list of plant materials on landscape planting plan. Plant species’ names shall be per 1996 Edition of Sunset Western Garden Book. Botanical names shall take precedence over common names.

B. Conditions: Plants shall be symmetrical, typical for variety and species, sound, healthy, vigorous, free from plant disease, insect pests or their eggs, excessive abrasions or other objectionable disfigurements, and shall have healthy, normal root systems, well-filling their containers, but not to the point of being root bound. Tree trunks shall be sturdy and well hardened-off. Plants shall not be pruned prior to delivery except as authorized by the Architect.

C. Ground cover plants (rooted cuttings) shall have been grown in flats and shall remain in those flats until time for transplanting. At time of transplanting, the flat soil shall contain sufficient moisture so that the soil does not fall apart when lifting plants from flat. Each plant shall be planted with its proportionate amount of the flat soil in a manner that will ensure a minimum of disturbance to the root system. Plants shall be fully developed and hardened off and shall be filling the flat.

D. In no case shall trees or shrubs be topped or pruned within 6 months prior to delivery. Plants shall be grown in nurseries that have been inspected by the State Department of Agriculture and have complied with its regulations.

E. Identification: plants shall be of the variety and size shown on the drawings, and shall conform to the requirements herein. One of each bundle or lot shall be tagged with plant name in accordance with recommendations of the American Association of Nurserymen.

F. Substitutions: substitutions for the indicated plant materials will be permitted, provided the substituted materials are reviewed in advance by the Architect, and the substitutions are made at no additional cost to the Owner. Except for the variations so authorized, all substitute plant materials shall conform to the requirements of these specifications. If accepted substitute materials are less value than those indicated or specified, the contract price will be adjusted in accordance with the provisions of the contract.

G. Container plant inspection and rejection: root condition of container plants will be determined by the Architect through the removal of plant from the container of at least two plants but not more than 2% of the total number of each species from each source.

H. Architect will inspect trees upon delivery. Trees and/or shrubs will be rejected if any one of the following characteristics is present:
   1. Enlarged cankers or galls at the base of the trunk, just above the soil level.
   2. Crooked trunks.
   3. Scars or trunk damage, broken branches, etc.
   4. Asymmetrical branching.
   5. Root-bound condition.
   6. Any trees that have been recently pruned back.
   7. All trees shall be matching in size and shape, if called for on the drawings or in these specifications.

I. Quantities: in all cases, quantities of plant material shall be furnished as needed to complete work as indicated on the drawings, including reseeding, replanting, and maintenance (replacements) during the contract period.

J. Sizes and Caliper: Minimum height (above soil level), width (average diameter of dripline), and caliper (trees only, measured at 30” above the soil level) of plant materials shall be as follows:
### 2.2 SOIL AMENDMENTS

A. All areas to be planted and irrigated shall receive soil amendments, except where specifically noted otherwise on the drawings.

B. Once all site improvements are in place and approximate finish grades established, the Contractor shall furnish to the Architect a soils report made from the surface and subsurface (18" below grade) soil by an approved agricultural lab. The report shall include pH, N-P-K, SAR, EC, boron levels, and soil particle size and textural evaluation. Architect shall review this report prior to commencement of soil preparation or planting, and recommend adjustments at the Architect's discretion.

1. Soil preparation for turf areas, amount per 1000 square feet:
   - 4 cu. yds. composted organic amendment per article 2.2.C
   - 50 lbs. Humate Plus (available from Tri-C Enterprises, Chino, CA, 800-927-3311)
   - 8 lbs. potassium sulfate (0-0-50)
   - 4lbs. triple superphosphate (0-45-0)
   - 25 lbs. 16-6-8 granular fertilizer
   - 200 lbs. agricultural gypsum
   - 10 lbs. Soil sulfur
   - 1-1/2lbs. ENDO-120 GRANULAR mycorrhize (available from Tri-C Enterprises, Chino, CA, 800-927-3311) applied per manufacturer guidelines

2. General soil preparation for areas which are less than 2:1 in slope aspect ratio, amount per 1000 square feet:
   - 6 cu. yds. composted organic soil amendment (per section 2.2.C)
   - 75 lbs. Humate Plus, (available from Tri-C Enterprises, Chino, CA, 800-927-3311)
   - 8 lbs. potassium sulfate (0-0-50)
   - 4lbs. triple superphosphate (0-45-0)
   - 25 lbs. 16-6-8 granular fertilizer
   - 300 lbs. Agricultural gypsum
   - 10 lbs. Soil sulfur
   - 1lb. ENDO-120 GRANULAR mycorrhize (available from Tri-C Enterprises, Chino, CA, 800-927-3311) applied per manufacturer guidelines

3. Top dress all slope areas 2:1 or steeper in slope aspect ratio with the following amendments, moderately raked into the soil (1-2 inch depth), amount per 1000 square feet:
   - 9 cu. ft. Composted organic soil amendment (per section 2.2.C)
   - 300 lbs. Agricultural gypsum
   - 10 lbs. Soil sulfur
   - 1 pint Sarvon soil penetrant (sprayer-applied).

C. Composted Organic Soil Amendment

1. Shall be Agri-Service 'Humic Compost', available from Agri-Service, Inc.
   - 3720 Oceanic Way, Suite 204 Oceanside, CA 92056
   - (800) 262-4167, or approved equal.

2. Product shall consist of a blend recycled garden waste, and wood by-products. It shall be properly cured for a minimum of 150 days, and be free from any trash, deleterious materials, and/or toxic chemicals. Product shall be non-hazardous, and conform to US...
Environmental Protection Agency 40 CFR 503 criteria for “Class A” product. It shall exceed standards and specifications for unrestricted application as a landscaping and agricultural soil amendment. Product shall contain no sewage sludge.

3. Product shall be rich, fully composted, 100% recycled organic product, consisting of 35% digested, centrifuged, composted bio-solids and 65% aged wood fibers.

4. For each product to be used, Contractor shall submit a sample and specification sheet, including particle size evaluation, total N (nitrogen), NH₄-N (ammonia), NO₃-N (nitrate), E₀E, pH, micro nutrients, and metals. Guaranteed analysis shall conform to the following, with a ±10% variance allowable:

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen</td>
<td>0.50%</td>
</tr>
<tr>
<td>(1) Organic N</td>
<td>0.40%</td>
</tr>
<tr>
<td>(2) Ammonium/N</td>
<td>0.09%</td>
</tr>
<tr>
<td>(3) Nitrate N</td>
<td>0.01%</td>
</tr>
<tr>
<td>Phosphorus (as P₂O₅)</td>
<td>8,684</td>
</tr>
<tr>
<td>Potassium (as K₂O)</td>
<td>5,485</td>
</tr>
<tr>
<td>Calcium</td>
<td>25,783</td>
</tr>
<tr>
<td>Copper</td>
<td>195</td>
</tr>
<tr>
<td>Iron</td>
<td>17,562</td>
</tr>
<tr>
<td>Magnesium</td>
<td>4,413</td>
</tr>
<tr>
<td>Manganese</td>
<td>283</td>
</tr>
<tr>
<td>Sulfur</td>
<td>4,927</td>
</tr>
<tr>
<td>Zinc</td>
<td>362</td>
</tr>
<tr>
<td>Boron</td>
<td>&lt;1.00ppm</td>
</tr>
<tr>
<td>Carbon:Nitrogen ratio</td>
<td>20:1</td>
</tr>
<tr>
<td>Organic matter (dry wt basis)</td>
<td>40%</td>
</tr>
<tr>
<td>E₀E</td>
<td>&lt;10.50 mmhos/cm</td>
</tr>
<tr>
<td>pH range</td>
<td>7.2-7.8</td>
</tr>
<tr>
<td>Moisture content</td>
<td>45-50%</td>
</tr>
<tr>
<td>Bulk density</td>
<td>1,100 lbs. per cu. yd.</td>
</tr>
</tbody>
</table>

5. Particle size shall be 100% passing a 1/2” screen.

D. The Contractor is responsible for correction of soil pH, nutrient levels, and chemical balance until final acceptance by the Owner. The Contractor shall take soil samples from three separate locations as directed by the Landscape Architect, and prepare soils reports by a testing service approved by the Landscape Architect. Prepare soils reports before preparing soil, at the start of the establishment period, on the 45th day of establishment period, and on the 80th day of establishment period. Correct any deficiencies identified at testing intervals by amending or top dressing as required, at no additional cost to the Owner.

2.3 SOD

A. Sod shall be “SEASHORE PASPALUM - PLATINUM TE”, warm season sod, as available from West Coast Turf 1365 Descanso Ave, San Marcos, CA 92069 (888)-893-TURF(8873)

B. Sod shall be machine cut at a uniform soil thickness of 5/8” plus or minus 1/4”. Measurements for thickness shall exclude top growth and thatch. Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard width and lengths shall be 2%. Broken rolls or slabs and torn or uneven ends will not be acceptable. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10% of the section.

C. Sod product shall be for turf repair areas and as shown on the drawings.

2.4 HYDROSEEDING MATERIALS

A. Hydroseed slurry composition shall be as follows:
Hydroseed Mix for turf

<table>
<thead>
<tr>
<th>Component</th>
<th>Pounds per 1,000 square feet</th>
<th>Guaranteed % Purity</th>
<th>Guaranteed % Germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose wood fiber</td>
<td>2000 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-C 6-2-4</td>
<td>8 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-8-8 granular fertilizer</td>
<td>1 pound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-C Endonet AMI</td>
<td>1 pound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arbusgular Mycorrhizal Inoculum 120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-48-0 monammonium phosphate</td>
<td>2-1/2 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-0-50 potassium sulphate</td>
<td>3-1/2 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-0-0 ammonium sulphate</td>
<td>2-1/2 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural gypsum</td>
<td>25 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composted organic amendment</td>
<td>50 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sarvon Soil Penetrant</td>
<td>1 pint</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. All seed shall be new crop seed labeled in accordance with US. Department of Agriculture rules and shall be furnished in sealed, standard containers. Seed that has become wet, moldy, or otherwise damaged, will not be acceptable.

C. Seed and/or stolon types shall be as specified and shall be applied at the rates indicated above.

D. Mulch material shall be clean, natural wood cellulose fiber. Natural wood cellulose fiber shall be processed in such a manner that it will contain no growth or germination inhibiting factors and shall be dyed green to facilitate metering of materials. It shall be manufactured in such a manner that after each addition and agitation in slurry tanks with fertilizer, seed, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry; and that when hydraulically sprayed, will uniformly cover the ground with seed and mulch, and which after application, will allow the absorption of moisture and will allow rainfall to percolate to the underlying soil. Materials that inhibit germination or growth shall not be present in the mixture.

E. Stabilization and water retaining agents shall be Ecology Controls "M" Binder, or approved equal.

F. Fertilizer shall be an approved standard brand conforming to pertinent State fertilizer laws, uniform in composition, dry, and free flowing.

G. Fertilizer shall be a commercial grade, uniform in composition, dry, and free flowing, of analysis as noted on drawings, and particle size of not less than 2% through a number 48 mesh.

H. Fertilizer shall be delivered to the site in the original unopened container, bearing the manufacturer's guaranteed analysis. Any fertilizer that becomes caked or damaged will not be acceptable.

2.5 EROSION CONTROL MATTING

A. Slopes steeper than 2:1 shall be protected with jute erosion control matting, properly staked and tied at 4' oc, maximum.

2.6 HEADER MATERIAL

A. Concrete headers and mow curbs shall be installed according to the details and in strict adherence to the dimensioning plan. Forms for the above shall be staked at 4 feet maximum intervals and all forming shall be approved, in the field, by the Architect, prior to pouring concrete. Mow curbs may be extruded if such methods are approved in advance by the Architect.
B. Forming stakes shall be at least one inch by two inches actual dimensions, of length necessary to extend into solid earth a minimum of twelve (12) inches.

C. Wood header shall be installed according to the respective details and in strict adherence to the drawings. Wood shall be 2"x4" or 1"x4" rough construction heart redwood, free from knots and splits. Wood stakes shall be 2"x4"x18" long construction heart redwood, secured to header with 12d common galvanized nails. When applicable, header shall be taped at 5 feet maximum intervals.

2.7 TREE STAKES

A. Tree stakes shall be 2" in diameter by 8’ or 10’ long new pine lodge poles treated with copper napthenate, per details.

B. Tree stakes for 30” box or larger trees shall be 3” in diameter.

C. Tree stakes for tree wells shall be 2” in diameter by 10’ long galvanized steel pipe with threaded galvanized cap on top end.

2.8 TIES

A. Tree ties shall be “Cinch-Tie” as manufactured by V.I.T. Products, Escondido, CA (619) 480-6702, or approved equal.

B. Use 30” long ties for 5 & 15-gallon trees, 36” long for 24” box and larger.

C. Use 1-1/4” or 1-1/2” long galvanized roofing nails to secure ties.

D. Espalier to wood surface: galvanized 1” staple and 1/2” wide “Tye-All” tie.

E. Espalier to concrete or stucco surface: 7/8” diameter aluminum flat washer or clear plastic “button” with wire hook secured to surface with G.E. clear silicone rubber and 1/2” wide “Tye-All” tie.

2.9 TREE GUYING MATERIALS

A. Anchors shall be Duckbill, Earth Anchor Systems, as manufactured by Forsight Products, Inc., or approved equal. Cable shall be non-coated, stainless steel braided cable, sized per manufacturer’s recommendations.

B. Anchor and Cable sizing shall be per the following schedule:

<table>
<thead>
<tr>
<th>Tree Caliper</th>
<th>Anchor</th>
<th>Cable size</th>
<th>Rated Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 3”</td>
<td>#40</td>
<td>1/16”</td>
<td>300 lbs.</td>
</tr>
<tr>
<td>3” to 6”</td>
<td>#68</td>
<td>1/8”</td>
<td>1,100 lbs.</td>
</tr>
<tr>
<td>6” to 11”</td>
<td>#88</td>
<td>3/16”</td>
<td>3,000 lbs.</td>
</tr>
</tbody>
</table>

C. Hose cable guards shall be new 5/8” rubber, brown or red.

D. Cable sleeves shall be new 1/2” white Schedule 40 PVC pipe. Cut to length according to details.

E. Cable clamps shall be hot dip galvanized. S-wedged fittings are not allowed, except at anchor.

2.10 IMPORT SOIL OR TOPSOIL

A. Import soil shall be Class A topsoil natural, friable, well-draining soil. Provide soil free from subsoil, brush, objectionable weeds, seeds, rocks, organic or inorganic debris, silt, and clay. The soil shall be free of any toxic substance, organic or inorganic; soil sterilants; salts; and no soil removed from roadbed excavations.
B. The Contractor shall furnish a soils report made form the intended import by an approved agricultural lab. The report shall include pH, N-P-K, SAR, minerals, micro-nutrients, EcE, boron levels, soil particle size, and textural elevation. Soil imported to site and found to be unsuitable by the Architect shall be removed from the site and replaced with an approved soil at the Contractor's expense. The Contractor shall pay all expenses for soil testing of import materials.

2.11 RESERVED

2.12 ORGANIC MULCH MATERIAL

A. Shall be Agri-Service ‘Forest Mulch’ as manufactured by Agri-Service, Inc. 720 Oceanic Way, Suite 204 Oceanside, CA 92056 (800) 262-4167, or approved equal.

B. Mulch shall consist of 100% recycled above ground tree products. Mulch shall contain no demolition wood waste, grass, weed seed, yucca, palm, bamboo, or other succulents or contaminants. Mulch shall be nitrogen stabilized and shall contain no trash, hazardous waste, or toxic materials.

C. Mulch shall be ground and screened to produce a 3” to 3/8” particle size.

2.13 PRE-EMERGENT HERBIQUE (SHRUB AND PLANTED GROUNDCOVER AREAS ONLY)

A. Pre-emergent herbicides shall be wettable powder or granular type.

B. Select pre-emergent herbicide appropriate to site area, soil type, indigenous weeds to be controlled, and type of ground cover to be planted.

C. Do not use pre-emergent herbicides in areas to be hydroseeded or stolonized.

D. Follow all manufacturer’s precautions and label instructions. Comply with all local jurisdictional restrictions and ordinances.

2.14 FERTILIZER TABLETS

A. Tablets shall be “Gro-Power Planting Tablets” as manufactured by Gro-Power, Inc.

B. Gro-Power 7 gram tablets.

2.15 MYCORRHIZA INOCULUM (ENDO-ECTO) PLANTER PACKETS

A. Myco-Pak ‘Tea-Bags’ (as manufactured by Tri-C Enterprises, Chino, CA, 800-927-3311)

B. Tri-C 7 gram size myco-pak

PART 3 - EXECUTION

3.1 SCHEDULING

A. Inspection

1. Prior to work of this section, carefully inspect previously installed work. Verify all such work is complete to the point where this installation may properly commence.

2. Verify that work of this section may be installed in strict accordance with the original design, all pertinent codes and regulations, and all pertinent portions of the referenced standards.

3. In the event of discrepancy, immediately notify the Architect.

4. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
B. Planting operations shall not commence until completion of all construction work, grading, soil preparation, weed control, and sprinkler installation.

C. Irrigation system shall be fully operational including automatic controller, before commencing planting operations.

3.2 SOIL PREPARATION

A. For areas to receive hydroseeding, sod, stolons, or flatted groundcovers only: irrigate site normally for two weeks to germinate weeds. Apply contact herbicide per manufacturer. Repeat process if required by Architect.

B. Special Leaching Requirements
   1. Leaching to lower EcE and SAR will be required. Preliminary soils test indicates an EcE >3.0 mmhos/cm.
   2. Auger holes to depths of 2, 3, and 4 feet at locations determined by the Architect. Fill these holes with 24 inches of water to determine percolation rate. Water percolation rate will determine depth of soil ripping, 12 inches to 24 inches.
   3. Submit results of percolation tests to Architect, which will specify depth of ripping. If percolation rate is ½ inch per hour or slower, Architect will propose alternate methods of achieving acceptable soil conditions for planting.
   4. Rip the soil in two directions to specified depth.
   5. Reduce soil crumb size to 1-1/2 inches diameter maximum by tilling or diskling.
   6. Add the amendments specified in article 2.2 to completely dry soil amounts. Exclude mycorrhize products during this phase.
   7. Rototill the soil to a depth of 8 inches and then water in.
   8. Apply water at ¼ inch per hour or at maximum rate of infiltration every hour until the top 6 inches of soil shows a EcE level of 3.0 or less. Leaching will continue until the top 18 inches can show the same EcE of 3.0 or less. Chlorides shall be 150 or less.
   9. Under no circumstances shall water be allowed to puddle.
  10. Test soil for EcE and SAR at two-week intervals. Contractor shall pay for cost of testing.
  11. After leaching operations are complete and acceptable EcE levels have been approved by the architect, soil-amending operations may proceed. Soil amendments specified in article 2.2 may be modified by results of most recent soils test.
  12. Irrigation system shall be installed and fully operational for soil leaching prior to start of planting phase.
  13. After leaching phase apply ammonium sulfate (21-0-0) at 5 pounds per 1000 square feet.

C. Rip in two directions, all areas to receive soil amendments to a minimum depth of 12 inches.

D. Remove all stones and hard clods 3” in diameter and larger from the top 6” of soil.

E. Apply soil amendments as specified, evenly and at the specified application rates.

F. Rototill top 6” of soil to a loose and friable consistency.

G. Finish grade to contours and spot elevations shown on drawings.

H. At time of planting, top 3” of soil in all areas to be planted or seeded shall be free of stones, stumps, roots, or other deleterious matter 1” in diameter or larger and shall be free from all wire, plaster, or similar objects that would be a potential hazard or hindrance to planting or maintenance.

I. Slopes steeper than 2:1 shall be raked smooth, but shall not receive soil amendments (except in plant pits, if any); unless specified on the drawings.

3.3 LANDSCAPE FINISH GRADE

A. Finish grading after soil preparation shall establish final flow lines and gradients for uniform water drainage. Flow lines and gradients shall be established from the high point to the drainage outlet or an inlet structure.
B. Finish grade for all lawn areas shall be 1" below sidewalks and curbs, except at locations where drainage water will flow onto or across hardscape, curbs, or paving. At these conditions the grade shall be flush or no more than 1/2" below hardscaping. Finished grades shall be of uniform slope and grade between points of fixed elevations or elevation controls. Finish grades shall be established from such points.

C. All finish grades shall be floated to assure a uniform surface without irregular dips or ridges. All turf areas shall be floated with a minimum 4' wide float and graded away from the established flowline. Roll all turf areas and refloat to eliminate depressions.

D. Contractor shall be responsible for bringing all shrub planting areas to finish grade after soil preparation which shall be 2" below paving and curbs or as noted by spot elevations. Special attention shall be given to maintaining continuous and even flow lines, and drainage away from structures, to drain inlet or outlet. Grades shall be established to drain all water away from structures behind walls. When drainage is difficult to achieve, the Contractor shall notify the Architect and request a solution before continuing. Grades in shrub areas shall be established prior to planting to ensure proper final planting heights.

E. All fill areas and constructed berms or mounds shall be compacted in even levels to compaction as specified in the geotechnical report.

3.4 SPACING / LOCATION OF PLANT MATERIALS

A. When plant material is spaced in rows, the total dimension shall be verified and the plants equally spaced within the designated area. When plant material is shown in a loose pattern, the Contractor shall space the material as shown on drawings and as directed by Architect. Ground cover material shall be triangularly spaced per dimension indicated on drawings (where applicable.)

B. All boxed and container stock shall be spotted on-site by the Contractor per drawings prior to planting. Plant pits shall not be excavated until the review of plant locations by the Architect.

C. The work shown on Planting Plans is schematic. All items, I.E. trees, shrubs, groundcovers, etc., are shown in their approximate locations only. Detail drawings may provide additional clarification or location of some items. Contractor shall not locate any items where it is obvious that they are in direct permanent improvements, or pedestrian and vehicular safety considerations. Contractor shall not install any plant materials in locations where the ultimate growth of the plant materials will damage or affect structures or impede pedestrian or vehicular circulation. Do not locate trees or taller shrubs in locations where they will block irrigation heads and prevent adequate coverage. Where called for, obtain approval of the landscape architect for placement of trees, shrubs, and other items of work.

D. Locate trees and taller shrubs 10’ minimum away from rotor irrigation heads, 5’ minimum from spray heads.

3.5 PLANT PITS AND PLANTING TECHNIQUE

A. Plant pits shall be dug with level bottoms with widths and depths as shown in detail drawings. Pits for trees shall be dug square. Fill pits with water and allow to drain out.

B. Plant holes dug by auger method will be acceptable, but shall have side walls roughened or squared with a shovel. Slick pit walls caused by auguring in too wet soil will not be accepted for planting.

C. Removal from metal containers: all canned stock 7 gallon size and under shall be vertically cut on two opposite sides with approved instruments for that purpose; 15 gallon size containers shall be cut on four opposite sides. Cutting with an axe or spade will not be permitted.

D. Handling: no canned plant material shall be planted if the ball is broken or cracked either before or during the process of planting.
E. Setting: plants shall be set with top of root ball 1"minimum and 2" maximum above finish grade. Each plant shall be placed in center of plant pit.

F. Pit Backfilling
1. Backfill material for plant pits shall be a mixture as noted below or as indicated on drawings. The materials shall be thoroughly batch-mixed prior to placement so that they are evenly distributed and without clods or lumps. Backfill shall be so placed in the pits that the plant will be at its natural growing height after settlement.
   - 80% by volume – leached and amended excavated soil, free from rocks, etc. (per section 3.2.6)
   - 10% by volume – composted organic soil amendment (per section 2.2.3)
   - 10% by volume – Washed corse placer sand #60 grade or better (free of weeds and deleterious matter)
   - 10 lbs - agricultural gypsum per cu. yd. of mix (per section 2.2)

2. Reserved
3. Reserved
4. Build mound of compacted backfill wide enough in bottom of hole to support root ball.
5. Backfill pit with backfill mix halfway to finish grade and water thoroughly.
6. Place 7 gram plant tablets and myco-paks in plant pits, adhering to the following schedule:
   - 1 gallon 1 30" box 5
   - 5 gallon 2 36" box 6
   - 15 gallon 3 42" box 7
   - 24" box 4 48" box 8

7. Backfill to finish grade. Backfill mix shall be tamped lightly, and a shallow basin formed at perimeter of root ball to hold enough water to saturate the root ball and backfill mix.
8. Water immediately to saturate entire root ball and backfill.
9. Remove watering basin prior to hydroseeding (in turf areas only).

G. Special Bougainvillea Planting Notes
1. Do not remove Bougainvilleas from containers. Place in hole and cut container on four sides. Be careful not to cut roots, or disturb integrity of root ball. Cut away sides of container and backfill per section 3.5.6, above.

H. Install tree root barriers, per details and section 329005.

3.6 TREE STAKING
A. Stake all trees as shown in details.
B. Tree and stakes shall be vertical in all cases.
C. One-gallon trees shall be planted with nursery stakes removed.

3.7 TREE GUYING
A. Guy 36" box and larger plant material with at least three guys in triangular pattern (see details). Wire shall be encased in new rubber hose where it comes in contact with tree. Locate loops on branches per details and so that cables do not chafe on each other or branches.
B. Use only manufacturer-approved driving rods for installation of anchors. Set anchor, using method recommended by manufacturer appropriate for size anchor being driven.
C. Guying requirement may be omitted by Architect when conditions permit.

3.8 SODDED LAWN
A. Sod shall be harvested, delivered and installed within a period of 24 hours, unless a suitable preservation method is approved prior to delivery. Sod not installed within this period shall be inspected and accepted by the Architect. Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect its uniformly at a height of 2" to 2-1/2" and all clippings removed.

B. Prepare sod bed per soil preparation specifications prior to installation of sod. Broadcast fertilizer as supplied by grower at 2 lbs./1,000 sq. ft. prior to laying sod.

C. Roll area to be sodded with water-filled roller to eradicate any possible air pockets. Fill any areas of settlement. Water thoroughly to a penetration depth of at least 6". Regrade soil if settling occurs. Order sod to be cut and delivered only after site is prepared for installation. Unroll sod in same direction each time. Sod shall be laid in a staggered pattern, with no gaps or voids. Cut rolls as necessary to fit, with no lengths shorter than 18". Start laying sod along longest straight edge and at bottom of slopes. Peg both ends of every roll of sod when laying sod along on slopes greater than 3:1. Pin down sod with wooden pegs, water sod within 30 minutes of laying. If sod ends against and open bed of soil, mound the soil against the new sod to keep the edges from drying, or regrade the soil to provide this protection automatically. Water thoroughly at the end of day all sod placed that day to penetrate soil at least 6".

D. Roll all sodded areas with a roller weighing approximately 16 pounds per lineal inch to compact the soil around the roots and provide a smooth, even mowing surface.

3.9 FLATTED GROUND COVER

A. Rooted cuttings shall be planted sufficiently deep to cover all roots and spaced as specified in ground cover list on landscape plan.

B. Rooted cuttings shall not be allowed to dry out before or while being planted. Wilted plants shall not be accepted.

C. At time of planting all ground cover plants, the earth around each plant shall be firmed sufficiently to force out all air pockets.

D. Each ground cover plant shall be planted with a minimum of one (1) 5 gram 20-15-5 plant tablet adjacent to root zone.

3.10 APPLICATION OF PRE-EMERGENT HERBICIDE(S)

A. Apply pre-emergent herbicide(s) to shrub and planted groundcover areas only. Do not apply to hydroseeded areas. Strictly adhere to manufacturer’s specifications for application rates and methods.

B. Apply pre-emergent(s) only after all planting operations have been completed so as to minimize disturbance of the chemical “barrier”. Reapply where necessary to any areas disturbed by planting or repair operations after initial application.

C. Pay careful attention to activation requirements, “watering-in”, etc., per manufacturer’s specifications and label instructions. Avoid excessive irrigation run-off that would move or wash away the pre-emergent “barrier” -- use repeat watering cycles and split watering times.

3.11 HYDROSEEDING / HYDROSTOLONIZING

A. After preparation of soil has been completed, the areas to be seeded shall be brought to a finish grade, with the finish surface being smooth and even, and reasonably well-firmed. It shall be the responsibility of the Contractor to make the entire area smooth and even, to ensure that finish grades shall be generally 1/2 inch below the surface of walks, curbs, paved areas, and yard boxes in all cases without abrupt changes in gradient (yard boxes shall be level).

B. The ground surface shall be inspected by the Architect prior to seeding to determine suitability for planting. The Contractor shall obtain such approval before seeding.
C. Equipment and application: hydraulic equipment used for the application of slurry shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix enough to prevent stoppage and to provide even distribution of the slurry over and ground. The pump shall be capable of exerting at least 150 PSI at the nozzle or sufficient additional pressure for proper coverage. The slurry tank shall have a minimum capacity of 1,500 gallon and shall be mounted on a traveling unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste and shall be thoroughly clean and free of seed species that are not specified.

D. With the engine at half throttle, water shall be added to the tank. When the water level has reached the height of the agitator shaft, good recirculation shall be established and at this time the seed shall be added. Fertilizer shall then be added to the mixture followed by wood pulp. Mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half-filled with water. All the wood pulp mulch shall be added by the time the tank is two-thirds to three-fourths full. Spraying shall commence when the tank is full.

E. Application: the operator shall spray the areas to be hydroseeded with a uniform, visible coat using the green color of the wood pulp as a guide. The slurry shall be applied in a sweeping motion, in an arched stream so as to fall like rain, allowing the wood fibers to build on each other until a good coat is achieved and the material is spread at the required rate per acre.

F. Time limit: all slurry mixture which has not been applied to the slopes within four hours after mixing will be rejected and removed from the project at the Contractor's expense.

G. Watering shall be as follows:
   1. Prior to hydroseeding, the areas shall be irrigated in order to provide a moist seed bed for the hydroseed application. Soil shall be at optimum moisture levels to a minimum depth of 4" below finish grade. Test with soil probe to confirm water penetration. Hydroseeding shall not take place until this requirement is met.
   2. Hydroseeded areas shall receive several consecutive waterings the day of the hydroseeding to thoroughly moisten the soil in the root zone.
   3. After initial irrigation, water shall be applied as often and in sufficient amounts as conditions may require, to keep the soil at optimum moisture levels above, around, and below the developing root systems of the plants (until germination is complete).

H. Reseeding: all bare spots shall be reseeded by the Contractor per specifications within thirty (30) days of installation. Reseeded areas that do not show prompt germination shall be again reseeded at ten-day intervals.

I. Machine Stolonizing Procedure

J. Mechanized grass stolon placement and procedures shall be as recommended by the turfgrass supplier and at the direction of the Architect.

3.12 MULCHING

A. After, planting operations are complete and shrubs areas have been raked and dressed, mulch all shrubs and ground cover areas with a 3" layer of organic mulch material.

B. Mulch layer should taper to zero at plant stem or tree trunk. Do not place mulch materials up against plant crown or trunk.

C. Mulch flattened ground cover areas prior to planting ground cover, if called for on the drawings.

3.13 PROTECTION
A. The Contractor shall carefully and continuously protect all areas included in the contract, including lawn areas, plant material, supports, etc. until final acceptance of the work by the Owner or his representative.

3.14 CLEAN-UP

A. After all planting operations are completed, Contractor shall remove all trash, excess soil, empty plant containers, or other accumulated debris from the site at no extra cost to Owner. Contractor shall repair all scars, ruts, or mars in area caused by work operations. Areas shall be left in a neat and orderly condition.

3.15 INSPECTIONS (PLANTING PHASE)

A. Contractor shall give forty-eight (48) hours notice and set appointment for all reviews by the Architect.

B. Review by Architect shall be scheduled for the following operations:
1. Review of finish grading.
2. Review of all plant material after delivery to the site.
3. Tree and shrubs placement prior to digging holes.
4. Review of ground cover lines and headerboard prior to planting.
5. Start of establishment period/acceptance of installation.
6. Final acceptance at end of establishment period.

C. Reviews shall be called for at the end of all planting operations for the purpose of determining compliance with drawings and specifications, intent, workmanship, and clean-up. Contractor shall secure written verification of review data, any corrections required to work, and limits of reviewed area before beginning the described establishment work.

D. In the event the Contractor requests inspection of work, and said work is substantially incomplete, the Contractor shall be responsible for Architect's hourly charges and per diem costs.

3.16 GUARANTEE

A. The plant Guarantee period begins on the date of written notification of Substantial Completion from the Construction Manager. The date of Substantial Completion may be different than the date of Substantial Completion of the other sections of the Project.

B. All shrubs, ground covers, lawn areas, and 15-gallon size trees or smaller shall be guaranteed as to growth and health for a period of ninety (90) days after notification of substantial completion; box sized trees shall be guaranteed for a period of one (1) year after date of substantial completion.

C. Plants that die or lose more than thirty percent (30%) of their original leaves shall be replaced under this section.

D. The Contractor, within fourteen (14) days of written notification by the Owner, shall remove and replace all guaranteed plant materials that for any reason fail to meet the requirements of the guarantee. All plants material replaced shall be guaranteed for the original period, starting from the date of replacement.

E. Any erosion or slippage of soil caused by watering shall be repaired by the Contractor at his expense.

F. All walks, curbs, and gutters shall be kept clear of debris, mud, dust, and standing water by sweeping, mopping or hosing down as required to maintain cleanliness throughout.

G. Contractor is responsible for protecting the work covered by this section from vandalism and accidental damage. Any damage shall be promptly repaired by the Contractor at no additional
cost to the Owner. Contractor is responsible for all repairs or replacements caused by acts of vandalism, including removal of graffiti, and/or refinishing, as required.

H. Contractor is responsible for protecting the work covered by this section from damage caused by frost and/or torrential rains. Any damage shall be promptly repaired by the Contractor at no additional cost to the Owner. Plant materials damaged by frost and/or torrential rains shall be replaced by the Contractor at no additional cost to the Owner.

END OF SECTION
SECTION 32 93 05

TREE ROOT BARRIERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Specified tree root barriers are: 1) a mechanical barrier and root deflector to prevent tree roots from damaging hardscapes and landscapes; and 2) an impermeable barrier to prevent migration of lime treatment into planted areas (36” deep).

B. 36” deep tree root barriers are assembled in 2’ long modules to create varying sizes of cylinders for surrounding root balls (Surround planting style) or for linear applications directly beside a hardscape adjacent to one side of the trees (Linear planting style) adjacent to lime-treated sub-grade.

C. 18” deep tree root barriers for linear applications are preassembled with flexible joiner strips in 52’ lengths for linear applications directly beside a hardscape adjacent to the trees. Each preassembled section can be separated or reconfigured in any 2’ module.

PART 2 - PRODUCTS

2.1 36” PLASTIC TREE ROOT BARRIERS

A. The Contractor shall furnish and install tree root barriers as specified. The tree root barriers shall be product #UB 36-2 as manufactured by Deep Root Partners, LP, 345 Lorton Avenue #103, Burlingame, CA 94010, (800) 458-7668, or approved equal.

B. The barriers shall be black, injection molded panels, of 0.085” wall thickness in modules 24” long by 36” deep; manufactured with a minimum 50% post-consumer recycled polypropylene plastic with added ultraviolet inhibitors; recyclable.

C. Each panel shall have:
   1. Not less than four (4) molded integral vertical root deflecting ribs of a minimum 0.085” thickness protruding 1/2” at 90° from interior of the barrier panel, spaced 6” apart.
   2. A double top edge consisting of two parallel, integral, horizontal ridges of a minimum 0.085” thickness, 3/8” wide and 1/4” apart with the lower rib attached to the vertical root deflecting ribs.
   3. A minimum of nine (9) anti-lift ground lock tabs consisting of integral horizontal ridges of a minimum 0.085” thickness in the shape of a segment of a circle, the 2” chord of the segment joining the panel wall and the segment, protruding 3/8” from the panel. The nine ground locks on each panel shall be about equally spaced between each of the vertical root deflecting ribs (3 between each set of ribs).

D. The basic properties of the material shall be:

<table>
<thead>
<tr>
<th>Test</th>
<th>ASTM Test Method</th>
<th>Value Copolymer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile stress @ yield</td>
<td>D638</td>
<td>3800 PSI</td>
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<tr>
<td>Elongation @ yield</td>
<td>D638</td>
<td>6.3%</td>
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<tr>
<td>Flexural Modulus</td>
<td>D790B</td>
<td>155,000 PSI</td>
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<tr>
<td>Notched Izod Impact</td>
<td>D256A</td>
<td>7.1</td>
</tr>
<tr>
<td>Rockwell Hardness r. scale</td>
<td>D785A</td>
<td>68</td>
</tr>
</tbody>
</table>

2.2 18” PLASTIC TREE ROOT BARRIERS FOR LINEAR APPLICATIONS
A. The Contractor shall furnish and install tree root barriers as specified. The tree root barriers shall be product # LB 18-2 as specified on the drawings as manufactured by Deep Root Partners, LP, 345 Lorton Avenue #103, Burlingame, CA 94010, (800) 458-7668, or approved equal.

B. The barriers shall be black, injection molded panels, of 0.080” wall thickness in modules 24” long by 18” deep; manufactured with a minimum 50% post-consumer recycled polypropylene plastic with added ultraviolet inhibitors; recyclable.

C. Each panel shall have:
   1. Not less than four (4) molded integral vertical root deflecting ribs of a minimum 0.06” thickness protruding 1/2” at 90° from interior of the barrier panel, spaced 6” apart.
   2. A double top edge consisting of two parallel, integral, horizontal ribs at the top of the panel of a minimum 0.06” thickness, 3/8” wide and 1/4” apart with the lower rib attached to the vertical root deflecting ribs.
   3. Not less than three (3) anti-lift ground lock tabs consisting of integral horizontal ridges of a minimum 0.06” thickness in the shape of a segment of a circle, the 2-1/4” chord of the segment joining the panel wall and the segment, protruding 3/8” from the panel. The minimum of three ground locks on each panel shall be about equally spaced between each of the vertical root deflecting ribs (1 between each set of ribs).
   4. A preassembled self-locking flexible (0°-180°) joiner strip to connect one panel to the next.

D. The basic properties of the material shall be:

<table>
<thead>
<tr>
<th>Test</th>
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</thead>
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</tr>
<tr>
<td>Notched Izod Impact</td>
<td>D256A</td>
<td>7.1</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 36” PLASTIC TREE ROOT BARRIERS (ADJACENT TO LIME-TREATED SUB-GRADE AREAS)

A. The Contractor shall install continuous tree root barriers along edge of paving or curb for any planted areas within 5’ of lime-treated sub-grade material. Only full panels shall be used.

B. The vertical root deflecting ribs shall be facing inwards to the root ball and the top of the double edge shall be 1/2” above grade.

C. Each of the required number of panels shall be connected to form a circle around the root ball or where specified joined in a linear fashion and placed along the adjacent hardscape or curb.

3.2 18” PLASTIC TREE ROOT BARRIERS (ADJACENT TO PAVING AND CURBS)

A. The Contractor shall install the tree root barriers in a linear fashion adjacent to paving, sidewalk, or curb in all conditions where trees are to be planted within 6’ or closer to these improvements. Root barriers shall extend 8’ on each side of tree as measured along length of improvement.

B. The vertical root deflecting ribs shall be facing inwards to the root ball and the double top edge shall be 1/2” above grade.

C. Each of the required number of panels shall be connected with the flexible joiner strips to the required length for the linear application. Use only full panels.

D. Barriers may be omitted for palm trees.
3.3 EXCAVATION

A. Excavation and soil preparation shall conform to the manufacturer’s specifications and details.

B. The tree root barriers shall be backfilled on the outside with 3/4” to 1-1/2” gravel or crushed rock as shown on the drawings. No gravel backfill is required for a linear installation.

C. Barriers may be installed in same trench with irrigation lines.

END OF SECTION
SECTION 32 97 00
LANDSCAPE & TURF ESTABLISHMENT

PART 1 - GENERAL

1.1 SUMMARY
A. This section covers all material, labor, accessories and appliances necessary for the complete establishment of Landscape and Turfgrass as indicated on the drawings and specified herein.
B. The General and Special Conditions of the contract apply to the work of this section the same as though written herein.

1.2 SCOPE OF WORK
A. Furnish all labor, material, and equipment necessary to establish and maintain all soil preparation, fertilization and turf grass as described herein and in the drawings.
B. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damage, injury, and loss due to his acts or neglect. Contractor shall continuously protect and maintain all areas included in the contract during the progress of the work, through the establishment period, and until final acceptance of the work. Contractor is responsible for all repairs or replacements caused by acts of vandalism, including removal of graffiti, and/or refinishing, as required.

1.3 RELATED SECTIONS
A. Section 32 80 00 - Irrigation System
B. Section 32 90 00 – Landscape

1.4 SUBMITTALS AND INSPECTIONS
A. Submittals shall conform to the provisions on Section 01 50 00.
B. Submit descriptive literature and manufacturer’s specification data for the following:
   1. Preliminary Irrigation Control schedule for establishment period.
C. Notify the Architect 48 hours prior to desired inspection.
D. Contractor shall call for the following inspections:
   1. Two weeks after turf seed germination
   2. 24 hours prior to first mowing
   3. 24 hours prior to second mowing
   4. Two weeks prior to termination of 90 Day Plant Establishment Period

PART 2 - PART 2 PRODUCTS

2.1 NOT USED

PART 3 - PART 3 EXECUTION

3.1 PREPARATION
A. Make provisions and take necessary precautions to protect existing work from damage during execution of this work.
3.2 SCHEDULING OF WORK

A. Prior to work of this section, carefully inspect previously installed work. Verify all such work is complete to the point where this installation may properly commence.

B. Verify that work of this section may be installed in strict accordance with the original design, all pertinent codes and regulations, and all pertinent portions of the referenced standards.

C. In the event of discrepancy, immediately notify the Architect.

D. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.3 APPROVALS

A. The Architect shall approve the following prior to execution of this work.
   1. Irrigation System
   2. Irrigation Control System
   3. Soil Preparation and Fine Grading
   4. Plant Material and Placement
   5. All submittals and shop drawings
   6. All requests for material substitution

3.4 TURF ESTABLISHMENT

A. Commencement of this period shall follow approval of turf seeding and turf sod application by the Architect.

B. This period has no time limitations, however the items listed in this section must be completed and approved prior to beginning the 90 day maintenance period.

C. Prior to approval to begin turf maintenance period, turf shall be completely germinated and established to permit two (2) mowings.
   1. First mowing shall take place when turf has reached a height of three inches. Submit written request to the Landscape Architect for approval to initiate first mowing.
   2. Submit written request to Landscape Architect for approval to initiate second mowing concurrently with written request for commencement of the 90-day maintenance period.

3.5 ESTABLISHMENT / MAINTENANCE PERIOD

A. Contractor shall continuously protect and maintain all areas included in the contract during the progress of the work, through the establishment period, and until final acceptance of the work.

B. The entire project shall be continuously and satisfactorily maintained for a period of ninety (90) calendar days. The Contractor shall call for the start of establishment period inspection only after the first mowing of hydroseeded grass. Establishment period shall commence upon the date of completion of the work, as authorized in a written notice from the Architect after the start of establishment period inspection has been completed and all punch list items have been corrected by the Contractor.

C. Continuous maintenance and establishment work includes all mowing, watering, weeding, reseeding, mulching, cultivating, spraying and trimming necessary to bring the planted areas to a healthy growing condition, and any additional work needed to keep the areas neat, edged, and attractive.

D. Watering:
   1. Water grass until final acceptance of work. The areas shall be kept moist, but not glistening wet, until time for the first cutting of grass. After first cutting, water turf to maintain a thriving condition. Do not overwater.
   2. Pay special attention to watering sloped areas planted with turf on the windward and / or sunny side so that lawn will be adequately watered at all times.
3. Monitor watering use on a daily basis, and make adjustments to controller watering schedule as necessary to apply only the proper amount of water at all times. Adjust watering schedule to compensate for changes in ETo, rainfall, and temperature.

4. Contractor shall only apply sufficient water to promote healthy growth of the plant material. At no time shall the contractor apply water at a rate or frequency which causes excess runoff or soil saturation.

5. Contractor shall maintain a daily log of watering times on the jobsite, and make it available for inspection by the Architect.

E. During the plant establishment period, all plants and planted areas shall be kept weed free at all times. Weeds, Nut grass, Dallas grass, Johnson grass, Bermuda grass, and any other noxious grass species shall be removed and disposed of as they appear.

F. Edging: The lawns should be edged whenever necessary. The lawn edges shall be continuously maintained in a neat condition until final acceptance of the work.

G. First mowing of hydroseneed grass shall occur before grass exceeds 4" in height. Grass shall be mowed with sharp and adjusted mowers, sized appropriately for the size(s) of the area(s) being mowed. Mowing heights for various types of turfgrass are given below:

<table>
<thead>
<tr>
<th>Turfgrass Type</th>
<th>1st Mowing</th>
<th>2nd &amp; Subsequent Mowings</th>
<th>Mower Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cool Season Grasses</td>
<td>2-1/2&quot;</td>
<td>1-1/2&quot;</td>
<td>Rotary</td>
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<tr>
<td>(Fescue, Ryegrass, Bluegrass)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bermudagrass &amp; Blends</td>
<td>1-1/2&quot;</td>
<td>1&quot;</td>
<td>Flail or Reel</td>
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</tbody>
</table>

H. Where trees occur in grass areas, the grass shall be removed and neatly edged 18" away from the trunks (36" diameter).

I. Workpersons shall not be allowed to walk on grass areas unnecessarily before, during, or after seeding operation. Grass areas that have been damaged or compacted shall be re cultivated and reseeded at the Contractor's expense.

J. Any day the Contractor fails to adequately water, replace unsuitable plants, weed, and other work determined to be necessary by the Architect, will not be credited as part of the establishment period.

K. During the establishment period, any plant indicating weakness or probability of dying, shall be replaced by the Contractor at his own expense.

L. Tree stakes which for any reason are damaged or rendered inadequate for support shall be repaired and restored to their original condition.

M. Constant diligence shall be maintained to detect the presence of disease, insects, and/or rodent infestations and proper preventative or control measures taken. This will be done at no additional cost to the Owner.

N. All shrubs and trees shall be maintained in their natural shapes. Tall or scraggly branches shall be thinned out where necessary. In no case shall trees or shrubs be trimmed by heading or shearing. Any plants severely pruned in this manner shall be removed and replaced at Contractor's expense.

O. On the 45th day of the establishment period, all lawns areas shall receive top dressing of ten (10) pounds of 16-8-8 commercial fertilizer per 1,000 square feet.

P. On the 80th day of the establishment period, all lawns lawn and ground cover areas shall receive top dressing of ten (10) pounds of 16-8-8 commercial fertilizer per 1,000 square feet.

Q. At completion of establishment period, all areas included in the contract shall be substantially clean and free of debris and weeds. All plant materials shall be live, healthy, and free of infestations.
R. Any erosion or slippage of soil caused by watering shall be repaired by the Contractor at his own expense.

S. All walks, curbs, and gutters shall be kept clear of debris, mud, dust, and standing water by sweeping, mopping or hosing down as required to maintain cleanliness throughout.

T. Contractor is responsible for protecting the work covered by this section from vandalism and accidental damage. Any damage shall be promptly repaired by the Contractor at no additional cost to the Owner.

U. Contractor is responsible for all repairs or replacements caused by acts of vandalism, including removal of graffiti, and/or refinishing, as required.

V. Contractor is responsible for protecting the work covered by this section from damage caused by frost and/or torrential rains. Any damage shall be promptly repaired by the Contractor at no additional cost to the Owner. Plant materials damaged by frost and/or torrential rains shall be replaced by the Contractor at no additional cost to the Owner.

3.6 END OF ESTABLISHMENT/MAINTENANCE PERIOD

A. At the end of the Warranty and Maintenance period the College’s Representative shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.
   1. If the work is satisfactory, the maintenance period will end at the established 90-day maintenance period and the Warranty and Maintenance period final walk.
   2. If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the College's representative.

B. FAILURE TO PASS OBSERVATION: If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the Owner’s Representative.

END OF SECTION
SECTION 33 11 00
WATER SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction of on-site water and fire service facilities and appurtenances, including the installation and testing of water system and services indicated for domestic water and fire services. The Contractor shall furnish and install pressure reducing valves, double check detectors, reduced pressure backflow preventers, fire hydrants, water meter, fire department connection, blowoffs, air release valves, gate valves and appurtenances, in accordance with the Governing Water District.

1.02 REFERENCES

A. Geotechnical Report:
1. Geotechnical investigation as been prepared under the direction of the Owner. Investigation is hereby referenced as information for the work of this section. Architect assumes no responsibility for conclusions the Contractor may draw, from information provided. The Contract Documents take precedence over recommendations that may be contained in the investigation and the contractor must obtain approval for any and all deviations from the Contract Documents. Copy of investigation is available at Architect's office. Copy investigation is bound herein as a reference only.

B. Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Standard Specifications:
   2. Standard Drawings:
      a. Standard Drawings, issued by Governing Water District, shall apply to the work to the extent referenced on plans.

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
   1. ASTM D1785 1999 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120
   2. ASTM D2466 2001 (Vinyl Chloride) (PVC) Plastic Pipe Fitting, Schedule 40
   3. ASTM D2564 1996 Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
   4. ASTM D2774 2001 Underground Installation of Thermoplastic Pressure Piping
   5. ASTM D2855 1996 Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings
   6. ASTM F402 1999 Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings

D. AMERICAN WATER WORKS ASSOCIATION
   1. AWWA C-900 1997 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings 4 in. through 12 in., for Water District
   2. AWWA C-509 2001 Resilient-Seated Gate Valves for Water Supply Service
   3. AWWA C-800 2001 Underground Services Line Valves and Fittings
   4. AWWA M-23 2002 PVC Pipe-Design and Installation
   5. AWWA M9 1995 Concrete Pressure Pipe
E. UNDERWRITERS LABORATORIES, INC. (UL)

F. UNI-BELL PLASTIC PIPE ASSOCIATION (UBPPA)
1. UBPPA UNI-B-8 1986 Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe

1.03 SUBMITTALS

A. Manufacturer's Catalog Data:
1. Pipe and Fittings.
2. Joints and Couplings.
3. Valves, including above-ground double check detector, post indicator valve and gate valves, reduced pressure Back Flow Preventer.
4. Valve and Meter Boxes.

B. Manufacturer's standard drawings or catalog cuts.

C. Certificates of Compliance:
1. Pipe and Fittings.
2. Pipe Joint Materials.
3. Valves

D. Certificates shall attest that products meet the requirements of the Governing Water District and that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage:
1. Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

B. Handling:
1. Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Carry, do not drag pipe to the trench. Store plastic piping, jointing materials that are not to be installed immediately, under cover out of direct sunlight.

PART 2 - PRODUCTS

2.01 WATER SERVICE LINE MATERIALS

A. Piping Materials:
1. Plastic piping and fittings shall bear the seal of the National Sanitation Foundation for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer and shall be in accordance with the Governing Water District's, "Equivalent Material List" contained in their standard specifications.
   a. Polyvinyl Chloride (PVC) Plastic Piping Less Than Six Inches in Diameter: SDR 14 with Class 200 pressure rating manufactured in accordance with AWWA
Standard C900, unless otherwise noted. Rubber waterlock rings shall be supplies by pipe supplier.

b. Polyvinyl Chloride (PVC) Plastic Piping Six to Twelve Inches in Diameter: SDR 25 with Class 165 pressure rating manufactured in accordance with AWWA standard C900, unless otherwise noted. Rubber water lockrings shall be supplied by pipe supplier.

B. Valves and Valve Covers:
1. Gate Valves and Butterfly Valves:
   a. Gate valves, including tapping valves, shall be resilient seat gate valves manufactured in accordance with AWWA standard C509.
   b. Butterfly valves shall be manufactured in accordance with AWWA Standard C504. Both gate valves and butterfly valves shall be listed on Governing Water District's approved materials list.
2. Gate Valve Covers and Gate Cans:
   a. All gate valve covers shall be 8 inch diameter cast iron, having the letters S.C.W. Co. and the word "Water" in raised letters on top. Gate material shall be 8 inch I.D. PVC pipe, schedule 40.
3. Post Indicator Valves, Double Detector Check Valves, Check Valves and reduced Pressure Backflow Preventers. Comply with the Governing Water District's approved material list.

C. Precast Meter Boxes and Vaults:
1. Comply with the Governing Water District's approved material list and the standard drawings referenced on the plans.

D. Water Main Appurtenances:
1. All water main appurtenances including, but not limited to fire hydrants, water meters, fire department connections, air and vacuum release valves, tapping sleeves, blow off assemblies, water services, brass fittings and iron fittings shall comply with the Governing Water District's approved materials list.

E. Refer to Section 21 11 00 "Facility Fire Suppression Water Service Piping" for fire service work outside of building structure (on-site) that is not part of this section.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPELINES

A. Installation of all water mains, appurtenances and water service shall conform to the Governing Water District's standard specifications.

B. The Contractor shall notify Underground Service Alert at 1-800-422-4133 at least two (2) days prior to starting work and shall coordinate all work with utility company representatives. The existence and locations of existing underground facilities indicated on the plans were obtained from a search of available records. The Contractor shall take precautionary measures to protect any existing facility indicated on the plans, and any other which is not of record or indicated on the plans.

C. Prior to commencing the work, the Contractor shall POTHOLE EXISTING UTILITIES at points of connection and notify engineer of record of discrepancies.

D. Contractor shall coordinate locations of stubouts from buildings with building plumbing Contractor.

E. Installation of Water Service Piping:
1. Location:
a. Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at the points indicated; such water service lines shall be closed with plugs or caps.

2. Service Line Connections to Water Mains:
   a. Domestic Service:
      1) The Contractor shall be responsible to install the service lateral, 2” ball valve curb stop with PVC pack joint inlet and outlet per the Governing Water District's standard drawings set in a No. 3 Water meter box with extensions. The Contractor shall be responsible to continue water service piping from the 2” water stop to the building terminus as specified in Paragraph 3.01A. above.

F. Special Requirements for Installation of Water Service Piping:
   1. Installation of Plastic Piping:
      a. Install pipe and fittings in accordance with Section 306-1.2, 306-1.2.13 of the standard specifications and the applicable requirement of ASTM D2774 and ASTM D2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F402.
         1) Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer. Make push-on joints in accordance with the recommendations of the manufacturer.
         2) Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

G. Pipe Anchorage:
   1. Provide concrete thrust blocks for water mains and fire service laterals in accordance with the Governing Water District's standards.

H. Trenching and Buried Warning Tape:
   1. Perform earthwork operations in accordance with Section 31 23 17, Trenching, including installation of buried warning tape.

I. Disinfection:
   1. Flush and disinfect all new water lines including reclaimed water lines and affected portions of existing potable water lines in accordance with AWWA C651. Apply chlorine by the continuous feed method.

3.02 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. The Contractor shall perform pipeline testing in accordance with Section 306-1.4 of the standard specifications and the Governing Water District's standard specifications.
   2. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications.

B. Testing Procedure:
   1. Test water mains and water service lines in accordance with the applicable specified standard. Test PVC plastic water service lines made with PVC plastic water main pipe in accordance with the requirements of UNI B3 for pressure and leakage tests. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at plastic pipe joints.
C. Special Testing Requirements:

1. For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger that 2 inches in diameter, hydrostatic test pressure shall be not less that 200 psi. Hold this pressure not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Backwater valves.
3. Cleanouts.
5. Precast concrete manholes.

1.2 REFERENCED STANDARDS

A. The editions and specifications and standards referenced herein, published by the following organizations apply to the construction only to the extent specified by the reference.

1. Standard Specifications:

2. Standard Drawings:
   b. American Water Works Association (AWWA).
   c. UNI-BELL Plastic Pipe Association (UNI).

1.3 DEFINITIONS


B. EPDM: Ethylene-propylene-diene-monomer rubber.

C. FRP: Fiberglass-reinforced plastic.

D. LLDPE: Linear low-density, polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.
G. PVC: Polyvinyl chloride plastic.
J. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS
A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.5 SUBMITTALS
A. Product Data: For the following:
   1. Submit manufacturers catalog data on pipe to be supplied.
   2. Submit affidavit of compliance with this spec and all reference specifications signed by authorized representative of the manufacturers.
   3. Special pipe fittings.
   4. Backwater valves.
B. Shop Drawings: For the following:
   1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
E. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS
A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Campus or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
1. Notify Campus’s Representative no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Campus’s Representative’s Campus’s written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS
A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS
A. Pipe: ASTM A 746, for push-on joints.
B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
C. Compact Fittings: AWWA C153, for push-on joints.
D. Gaskets: AWWA C111, rubber.

2.4 DUCTILE-IRON PRESSURE PIPE AND FITTINGS
A. Pipe: AWWA C151, for push-on joints.
B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
C. Compact Fittings: AWWA C153, for push-on joints.
D. Gaskets: AWWA C111, rubber.

2.5 PVC PIPE AND FITTINGS
A. PVC Pressure Pipe: AWWA C900, Class 200, for gasketed joints and using ASTM F 477, elastomeric seals.
   1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
   2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.
B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings.

C. PVC Sewer Pipe and Fittings:

1. Pipe and Fittings: Shall conform to ASTM D 3033 or ASTM D 3034, shall be SDR 35, with ends suitable for elastomeric gasket joints. Pipe shall meet requirements of UNI-B-10-88.
3. Pipe Stiffness: Minimum pipe stiffness (@ 5% deflect) shall be 46 for all sizes when tested in accordance with ASTM D 2412.
4. Flattening: There shall be no evidence of splitting, cracking, or breaking when the pipe is tested as follows:
   a. Flatten specimen of pipe, six inches long between parallel plates in a suitable press until the distance between the plates is forty percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes.
5. Products: Ringtite greenbell PVC sewer pipe, Johns-Manville, Denver, Colorado; Fluidtite PVC sewer pipe, Certainteed Corporation, Anaheim, California; or equal.

D. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.6 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   b. Fernco Inc.
   c. Logan Clay Products Company (The).
   d. Mission Rubber Company; a division of MCP Industries, Inc.
   e. NDS Inc.
   f. Plastic Oddities, Inc.
   g. Or Equal.

D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
1. Manufacturers:
   a. Fernco Inc.
   b. Logan Clay Products Company (The).
   c. Mission Rubber Company; a division of MCP Industries, Inc.
   d. Or Equal.

E. Nonpressure-Type, Rigid Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. ANACO.
   b. Or Equal.

2.7 SPECIAL PIPE FITTINGS

A. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

1. Manufacturers:
   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products.
   d. Or Equal.

2.8 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:
   b. MIFAB Manufacturing Inc.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
   h. Or Equal.

2. Top-Loading Classification: Heavy duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
1. Manufacturers:
   a. Canplas Inc.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.
   g. Or Equal.

2.9 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
12. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

B. Manhole Cover Inserts: Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.

1. Manufacturers:
   a. FRW Industries; a Syneco Systems, Inc. company.
   b. Knutson Enterprises.
   c. L.F. Manufacturing, Inc.
   d. Parson Environmental Products, Inc.
   e. Or Equal

2. Type: With drainage and vent holes.
2.10 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
   1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
   1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
      a. Invert Slope: 2 percent through manhole.
   2. Benches: Concrete, sloped to drain into channel.
      a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.11 MISCELLANEOUS MATERIALS

A. Paint: SSPC-Paint 16.

B. PE Sheeting: ASTM D 4397, with at least 8-mil thickness.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 STORAGE OF MATERIALS

A. Inspect all materials delivered to the site for damage. Store materials on site in enclosures or under protective covering out of direct sunlight. Do not store materials directly on ground. Keep inside of pipes and fittings free of dirt and debris.
3.3 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
   a. Unshielded flexible or rigid couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping’s OD and larger piping’s ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:
   1. NPS 3: NPS 6 ductile-iron, gravity sewer pipe or NPS 3 or NPS 4 ductile-iron pressure pipe; ductile-iron standard or compact fittings; gaskets; and gasketed joints.
   2. NPS 3: PVC water-service pipe; PVC Schedule 40, water-service-pipe fittings; and solvent-cemented joints.
   3. NPS 3: NPS 4 PVC sewer pipe and fittings, gaskets, and gasketed joints.
   4. NPS 4: PVC water-service pipe; PVC Schedule 40, water-service-pipe fittings; and solvent-cemented joints.
   5. NPS 4: PVC sewer pipe and fittings, gaskets, and gasketed joints.
   6. NPS 5 and NPS 6: NPS 6 PVC sewer pipe and fittings, gaskets, and gasketed joints.

3.4 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install pipe in accordance with ASTM D 2321, UNI-B-5 and the following:

C. Inspect each pipe and fitting before lowering the pipe or fitting into the trench. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

D. Use implements, tools, and facilities for the safe and proper protection of the pipe. Handle pipe in such a manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

E. When installing piping in trenches, do not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.

F. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing...
and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

G. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit visual inspection of the entire joint.

H. Provide and maintain means and devices at all times to remove and dispose of all water entering the trench during the process of pipelaying. The trench shall be kept dry until the pipelaying and jointing are completed. Removal of water shall be in conformance with specifications in Section 01065.

I. When the pipelaying is not in progress, including the noon hours, close the open ends of pipe. Do not permit trench water, animals, or foreign material to enter the pipe.

J. Lay pipe without break, upgrade from structure to structure, with the bell ends of the pipe upgrade.

K. Do not use the pipe as a drain for removing water that has infiltrated into the trench.

L. After joint assembly, bring the bedding material up to 1 foot above the top of the pipe. Place and compact the imported sand as directed in Section 02 30 00. The remainder of the backfill shall be native earth backfill, installed per Section 02 30 00.

M. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

N. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

O. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.

P. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 36-inch minimum cover.
4. Install ductile-iron, gravity sewer piping according to ASTM A 746.
5. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
6. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
7. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
8. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

Q. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:

2. Hubless cast-iron soil pipe and fittings.
3. Ductile-iron pipe and fittings.
4. Special pipe fittings.

R. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.
3.5 PIPE JOINT CONSTRUCTION

A. Apply the joint manufacturer's lubricant to the pipe spigot to assemble the joint. Follow the manufacturer's instructions. Make joints water tight and root tight.

B. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
   2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
   3. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
   4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   5. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   6. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

3.6 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.

E. Install FRP manholes according to manufacturer's written instructions.

F. Form continuous concrete channels and benches between inlets and outlet.

G. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

H. Install manhole cover inserts in frame and immediately below cover.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.8 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated.

B. Install combination horizontal and manual gate valve type in piping and in manholes where indicated.

C. Install terminal-type backwater valves on end of piping and in manholes where indicated. Secure units to sidewalls.
3.9 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Instructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.10 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

B. Connect pressure, force-main piping to building's sanitary force mains specified in Division 15 Section "Sanitary Waste and Vent Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.11 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

2. Close open ends of piping with at least 8-inch thick, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 2 Section "Earthwork."

3.12 PAINTING

A. Clean and prepare concrete manhole surfaces for field painting. Remove loose efflorescence, chalk, dust, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:

1. Cast-in-Place-Concrete Manholes: All interior.
2. Precast Concrete Manholes: All interior.

B. Prepare ferrous frame and cover surfaces according to SSPC-PA 1 and paint according to SSPC-PA 1 and SSPC-Paint 16. Do not paint surfaces with foundry-applied corrosion-resistant coating.

3.13 IDENTIFICATION

A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.14 TESTING FOR ALIGNMENT

A. After the pipe has been installed, tested for leakage, backfilled to existing grade, and manholes raised to grade and resurfaced, "ball" the pipe from manhole with a sewer scrubbing ball. After balling the pipe, perform the following.

B. "Mirror" straight sewers and inlet/outlet ends of curvilinear sewers. Perform balling and mirroring in the presence of the Campus's Representative to test for alignment, grade, damage or defective pipe in place, or any other type of faulty installation. Should balling and mirroring indicate any faulty installation of the pipe, repairs or replacements shall be made at the Contractor's expense.

3.15 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

c. Crushed, broken, cracked, or otherwise damaged piping.

d. Infiltration: Water leakage into piping.

e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test for leakage by means of a water test. Test each section of pipe between manholes, along with the manholes.

3. Even though a section may have previously passed the leakage test, test each section of sewer subsequent to the last backfill compacting operation in which heavy compaction equipment may have damaged or affected the required watertight integrity of the pipe, structure, or appurtenance.

4. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

5. Submit separate report for each test.

6. WATER TEST

   a. Test each section of pipe between two successive structures by closing the lower end of the pipe to be tested and the inlet pipe of the upper structure with plugs or stoppers. Fill the pipe and structure with water to a point 4 feet above the invert of the open pipe in the upper structure, or to a height of 10 feet above the invert of the sewer in the lower structure, whichever gives the less hydrostatic pressure on the lower structure.

   b. The total leakage shall be the decrease in volume of water in the upper structure. The leakage shall not exceed 0.025 gpm per inch of nominal diameter of pipe per 1,000 feet of sewer pipe being tested. Do not use the length of lateral connections in computing the length of pipe being tested.

   c. If the leakage is greater than allowed, overhaul the pipe and, if necessary, replace and relay until the joints and pipe comply with this test. Complete tests before trench is paved.

7. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

8. Option: Test plastic gravity sewer piping according to ASTM F 1417.


10. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

11. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
3.16 CLEANING

A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

3.17 CLOSEOUT DOCUMENTATION

A. Video Documentation: Upon completion of sitework, hardscaping, landscaping and pipe cleaning, televise and record on DVD storm drain piping installed as part of the Project (outside the building footprint) as follows:

1. Notify Project Inspector at least two days prior to scheduled recording.
2. Include audio narration.

B. Report: Prepare a written report of the video documentation, including the following:

1. Camera location, identified by Campus’s storm drain numbering system.
2. Pipe sections being viewed.
   a. Markup pipe section in conjunction with storm drain Drawings.

C. Submit DVD, written report, and Drawing markups to Campus in accordance with Division 1 Section "Project Closeout."

END OF SECTION 33 31 00
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Backwater valves.
3. Cleanouts.
4. Drains.
5. Corrosion-protection piping encasement.

1.2 REFERENCED STANDARDS

A. The editions and specifications and standards referenced herein, published by the following organizations apply to the construction only to the extent specified by the reference.

B. Standard Specifications:


C. Standard Drawings:

3. UNI-BELL Plastic Pipe Association (UNI).

D. American Society for Testing Materials (ASTM) publications shall apply as referenced:

1. C 76-85a Reinforced Concrete, Culvert, Storm Drain and Sewer Pipe.
2. C 150 85a Cement, Portland.

1.3 DEFINITIONS

B. EPDM: Ethylene-propylene-diene-monomer rubber.

C. FRP: Fiberglass-reinforced plastic.

D. LLDPE: Linear low-density, polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.


J. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Submit manufacturers catalog data on pipe to be supplied.
   2. Special pipe fittings.
   4. Drains.
   5. Channel drainage systems.
   6. Storage and leaching chambers.
   7. Manufacturers confirmation that products supplied comply with referenced standards.

B. Shop Drawings: For the following:
   1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
   2. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
   3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.
   4. Manufacturer's catalog data. Reinforced Concrete Pipe (Storm Drain):
      a. Shop fabrication details showing materials, reinforcements, and joint details.
      b. Field layout drawings showing location and dimensions of pipe, fittings, and connecting structures.
C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Campus or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Campus’s Representative no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Campus’s Representative’s written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
2.3 PVC PIPE AND FITTINGS

A. PVC Pressure Pipe: AWWA C900, Class 200, for gasketed joints and using ASTM F 477, elastomeric seals.

1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings.

C. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness pipe with ASTM D 3034, SDR 35, socket-type fittings for solvent-cemented joints.

D. PVC Sewer Pipe and Fittings: Conforming to ASTM D 3033 or ASTM D 3034; SDR 35, with ends suitable for elastomeric gasket joints.

1. Pipe: Meeting requirements of UNI-B-10-88.
3. Pipe Stiffness: Minimum of 46, at 5 percent deflection, for all sizes when tested in accordance with ASTM D 2412.
4. Flattening: Showing no evidence of splitting, cracking or breaking when tested as follows:
   
a. Flatten specimen of 6-inch-long pipe between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes.

5. Products: Subject to compliance with requirement, provide one of the following, or equal:
   
a. Johns-Manville; Ringtite Greenbell PVC sewer pipe.
   b. Certainteed Corporation; Fluidtite PVC sewer pipe.


F. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.4 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   b. Fernco Inc.
   c. Logan Clay Products Company (The).
   d. Mission Rubber Company; a division of MCP Industries, Inc.
   e. NDS Inc.
   f. Plastic Oddities, Inc.
   g. Or Equal.

D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. Cascade Waterworks Mfg.
   c. Mission Rubber Company; a division of MCP Industries, Inc.
   d. Or Equal.

E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1. Manufacturers:
   a. Fernco Inc.
   b. Logan Clay Products Company (The).
   c. Mission Rubber Company; a division of MCP Industries, Inc.
   d. Or Equal.

F. Nonpressure-Type Rigid Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. ANACO.
   b. Or Equal.
2.5 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:
   b. MIFAB Manufacturing, Inc.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
   h. Or Equal.

2. Top-Loading Classification(s): Heavy duty.

3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

1. Manufacturers:
   a. Canplas Inc.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products.
   g. Or Equal.

2.6 DRAINS

A. Gray-Iron Area Drains: ASME A112.21.1M, round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Manufacturers:
   b. MIFAB Manufacturing, Inc.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
   h. Or Equal.

2. Top-Loading Classification(s): Heavy duty.
B. Gray-Iron Trench Drains: ASME A112.21.1M, 6-inch wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular secured grate. Include units of total length indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated.

1. Manufacturers:
   c. Wade Div.; Tyler Pipe.
   d. Watts Industries, Inc.
   g. Or Equal.

2. Top-Loading Classification(s): Heavy duty.

2.7 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
12. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

   a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil minimum thickness applied to all surfaces, unless otherwise indicated.

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.9 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings. ADA Compliant grates are required in all locations.

1. Size: 24 by 24 inches minimum, unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter flat grate with Small Square or short-slotted drainage openings. ADA Compliant grates are required in all locations.

1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.10 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy-duty frames and grates according to utility standards.

E. Curb Inlets: Vertical curb opening, of materials and dimensions indicated.

F. Gutter Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy-duty frames and grates.

G. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

H. Frames and Grates: Dimensions, opening pattern, free area, and other attributes indicated.

2.11 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.
2. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and cover.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter cover. Include indented top design with lettering "STORM SEWER" cast into cover.
2.12 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregular size and shape, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."


2.13 STORMWATER DISPOSAL SYSTEMS

A. Chamber Systems:

1. Manufacturers:
   a. Advanced Drainage Systems, Inc.
   b. Cultec, Inc.
   c. Hancor, Inc.
   d. Infiltrator Systems, Inc.
   e. Or Equal.

2. Storage and Leaching Chambers: Molded PE with perforated sides and open bottom. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.

3. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

4. Filter Mat: Geotextile woven or spun filter fabric, in 1 or more layers, for minimum total unit weight of 4 oz./sq. yd..

B. Pipe Systems: Perforated manifold, header, and lateral piping complying with AASHTO M 252M for NPS 10 and smaller, AASHTO M 294M for NPS 12 to NPS 48, and AASHTO MP7 for NPS 54 and NPS 60. Include proprietary fittings, couplings, seals, and filter fabric.

1. Manufacturers:
   a. Advanced Drainage Systems, Inc.
   b. Hancor, Inc.
   c. Or Equal.

2.14 MISCELLANEOUS MATERIALS

A. Paint: SSPC-Paint 16.
B. PE Sheeting: ASTM D 4397, with at least 8-mil thickness or other equivalent, impervious material.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 STORAGE OF MATERIALS

A. Inspect all materials delivered to the site for damage. Store materials on site in enclosures or under protective covering out of direct sunlight. Do not store materials directly on ground. Keep inside of pipes and fittings free of dirt and debris.

3.3 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
   a. Unshielded flexible or rigid couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:

   1. NPS 3: ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
   2. NPS 3: NPS 4 PVC sewer pipe and fittings; gaskets; and gasketed joints.
   3. NPS 4 and NPS 6: Cellular-core PVC pipe, PVC sewer pipe fittings, and solvent-cemented joints.
   4. NPS 4 and NPS 6: PVC sewer pipe and fittings, gaskets, and gasketed joints.
   5. NPS 8 to NPS 12: PVC sewer pipe and fittings, gaskets, and gasketed joints.
   6. NPS 8 to NPS 12: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.
   7. NPS 15: PVC sewer pipe and fittings, gaskets, and gasketed joints.
   8. NPS 15: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.
9. NPS 18 to NPS 36: PVC sewer pipe and fittings, gaskets, and gasketed joints.
10. NPS 18 to NPS 36: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.

3.4 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install pipe in accordance with ASTM D 2321, UNI-B-5 and the following:

1. Inspect each pipe and fitting before lowering the pipe or fitting into the trench. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
2. Use implements, tools, and facilities for the safe and proper protection of the pipe. Handle pipe in such a manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.
3. When installing piping in trenches, do not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.
4. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.
5. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit visual inspection of the entire joint.
6. Provide and maintain means and devices at all times to remove and dispose of all water entering the trench during the process of pipelaying. The trench shall be kept dry until the pipelaying and jointing are completed. Removal of water shall be in conformance with specifications in Section 01065.
7. When the pipelaying is not in progress, including the noon hours, close the open ends of pipe. Do not permit trench water, animals, or foreign material to enter the pipe.
8. Lay pipe without break, upgrade from structure to structure, with the bell ends of the pipe upgrade.
9. Do not use the pipe as a drain for removing water that has infiltrated into the trench.
10. After joint assembly, bring the bedding material up to 1 foot above the top of the pipe. Place and compact the imported sand as directed in Section 02300. The remainder of the backfill shall be native earth backfill, installed per Section 02300.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
2. Install piping with 36-inch minimum cover.
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
4. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

3.5 PIPE JOINT CONSTRUCTION

A. Apply the joint manufacturer's lubricant to the pipe spigot to assemble the joint. Follow the manufacturer's instructions. Make joints water tight and root tight.

B. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
2. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
3. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.7 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use heavy-duty, top-loading classification drains in vehicle-traffic service areas.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.
3.8 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.
B. Install precast concrete manhole sections according to ASTM C 891.
C. Construct cast-in-place manholes as indicated.
D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.
E. Install FRP manholes according to manufacturer's written instructions.
F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.9 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.
B. Set frames and grates to elevations indicated.

3.10 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
B. Construct riprap of broken stone, as indicated.
C. Install outlets that spill onto grade, anchored with concrete, where indicated.
D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
E. Construct energy dissipaters at outlets, as indicated.

3.11 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.12 DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer's written instructions.
B. Install with top surfaces of components, except piping, flush with finished surface.
C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
D. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.

E. Fasten grates to channel sections if indicated.

F. Assemble channel sections with flanged or interlocking joints.

G. Embed channel sections in 4-inch minimum concrete around bottom and sides.

3.13 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill according to piping manufacturer's written instructions.

3.14 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 15 Section "Storm Drainage Piping."

B. Connect force-main pressure piping to building's storm drainage force mains specified in Division 15 Section "Storm Drainage Piping." Terminate piping where indicated.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
3.15 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 2 Section "Earthwork."

3.16 PAINTING

A. Clean and prepare concrete manhole surfaces for field painting. Remove loose efflorescence, chalk, dust, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:

1. Cast-in-Place-Concrete Manholes: All interior.
2. Precast Concrete Manholes: All interior.

B. Prepare ferrous frame and cover surfaces according to SSPC-PA 1 and paint according to SSPC-PA 1 and SSPC-Paint 16. Do not paint surfaces with foundry-applied, corrosion-resistant coating.

3.17 IDENTIFICATION

A. Materials and their installation are specified in division 2 Section "Earthwork." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.18 TESTING FOR ALIGNMENT

A. After the pipe has been installed, tested for leakage, backfilled to existing grade, and manholes raised to grade and resurfaced, "ball" the pipe from manhole with a sewer scrubbing ball. After bailing the pipe, perform the following:
B. "Mirror" straight sewers and inlet/outlet ends of curvilinear sewers. Perform balling and mirroring in the presence of the Campus's Representative to test for alignment, grade, damage or defective pipe in place, or any other type of faulty installation. Should balling and mirroring indicate any faulty installation of the pipe, repairs or replacements shall be made at the Contractor's expense.

3.19 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours’ advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Exception: Piping with soil-tight joints unless required by authorities having jurisdiction.
   b. Option: Test plastic piping according to ASTM F 1417.
   c. Option: Test concrete piping according to ASTM C 924.
6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.
   a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
   b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.
D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.20 CLEANING
A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

3.21 CLOSEOUT DOCUMENTATION
A. Video Documentation: Upon completion of sitework, hardscaping, landscaping and pipe cleaning, televise and record on DVD storm drain piping installed as part of the Project (outside the building footprint) as follows:

1. Notify Project Inspector at least two days prior to scheduled recording.
2. Include audio narration.

B. Report: Prepare a written report of the video documentation, including the following:

1. Camera location, identified by Campus's storm drain numbering system.
2. Pipe sections being viewed.
   a. Markup pipe section in conjunction with storm drain Drawings.

C. Submit DVD, written report, and Drawing markups to Campus in accordance with Division 1 Section "Project Closeout."

END OF SECTION 33 41 00
GUIDELINE A
GRAPHICAL USER INTERFACE REQUIREMENTS

INTRODUCTION

PURPOSE AND SCOPE

This Guideline provides requirements for the graphical user interface (GUI) requirements associated with MCCCD’s IAS system. The intent of the requirements are to provide consistent and functional IAS graphics across all MCCCD systems regardless of the controls system manufacturer or installation contractor selected for each project.

BACKGROUND

MCCCD is standardized on a third party visualization software to serve as the primary user interface for the IAS network. The Graphical User Interface on the IAS network shall be provided in whole through DGLogik DGLux5 (aka Atrius Solution Builder) visualization software. All IAS Command and Control and functionality shall be provided within the DGLux environment. Embedded screen interfaces from other thin client applications are not acceptable.

REQUIRED SUBMITTALS

Guideline A - Specific Submittals:

- Sample Graphic Screens: the IAS Installation Contractor shall submit sample graphic screens at the Issued for Construction drawings submittal stage for Government review. The following graphic screens shall be provided:
  - proposed equipment pages for each unique HVAC system in the project
  - A proposed sample HVAC floor plan including a project specific three-dimensional floor plan rendering.
  - The proposed facility homepage including the building three-dimensional rendering
  - The proposed facility alarm management page
  - The proposed facility energy dashboard page
  - The proposed facility fault detection and diagnostics overview page

GRAPHIC INTERFACE REQUIREMENTS - GENERAL

GENERAL

The IAS Installation Contractor shall configure the project graphics to adhere to the specific requirements described in the following sections of this Guideline. Each graphic developed by the contractor shall include all control points, devices and user adjustable set points/parameters associated with the system. Vendor names, logos, hyperlinks to a vendor website, or other vendor identification or promotion, are not permitted on the graphics other than a reference to the graphics producer as described in the Graphics Page Header section below. Each graphic page shall be submitted for review and requires approval by the MCCCD and Design Team. Any exceptions or additions to the graphic requirements shall be reviewed and approved by the MCCCD Project Manager.
GRAPHICS PAGE HEADER

- The same project header shall appear on each graphic page in the GUI.
- The header and each of the link buttons shall appear the same on all MCCCD IAS systems.
- All links, labels and reference in the header graphics shall be tied into a single template file to allow for global edits.
- A sample header is shown below:

![Sample Header Image]

Specific Requirements:

1) Graphics Page Title shall be displayed at the center of the header.
2) MiraCosta Community College District (MCCCD) Logo and Name shall be displayed. The name of the IAS contractor who builds the graphic page shall be listed below MCCCD’s name in the “Graphics by (Insert IAS Vendor Name)”.
3) Current outdoor temperature and weather conditions shall be displayed. The weather forecast for the next two days shall be displayed.
4) Schedules, Alarms, Trends, FD&D, and Users links shall be provided where shown on every page, and shall direct the user to the overview page for each.
5) Indicate Oceanside Campus central plant live running capacity and efficiency.
6) Display the number of unacknowledged IAS alarms.
7) Provide a selection to sort navigation based on location, equipment, or network.
   a. In Location based navigation, the drop down links shall be Campus -> Building -> Floor as shown above.
   b. In Equipment based navigation, the drop down links shall be Plant -> AHU -> Zone
   c. In Network based navigation, the drop down links shall be Server -> JACE -> BACnet Device
8) Drop down navigation display links. The navigation tree shall change based on whether Location, Equipment, or Network is selected above.
IAS HOME PAGE

- The home page shall provide an operator with a region map of the MCCCD campuses tied to the IAS system with each building clearly labeled.
- Links to individual building home pages shall be provided based on selecting the campus location icon.
- The Google Map component shall be a customizable, interactive Google Map, with styling as shown, based on DGLux5's Google Maps API feature. Static image map backgrounds are not acceptable.
- A sample IAS Home Page is shown below:

![IAS Home Page Image]

Specific Requirements:

1) Header Displayed
2) A hover-over of the campus location icon shall bring up the campus name and photo. Each display shall link to the individual Building Home Page or the Campus Home Page if more than one MCCCD building is located on the campus.
BUILDING OR CAMPUS HOME PAGE

- The Campus Home page shall include an enlarged view of the campus through the interactive Google Map required in the IAS home page.
- A sample building / campus home page graphic is shown below:

![Campus Home Page Graphic](image)

**Specific Requirements:**

1) A mouse-over on any building shall highlight the building and display the building name. Clicking on the selected floor shall navigate the user to the floor plan display.
2) Provide an overview of the facility cooling signal by displaying the CHW valve signals (%) of all air handling units for hydronic systems. For DX systems, display the cooling percentage in terms of Compressor Power/Max Compressor Power.
MCCCD CLC STUDENT SERVICES BUILDING
GUIDELINE A - GRAPHICAL USER INTERFACE REQUIREMENTS

GRAPHICAL INTERFACE REQUIREMENTS- FLOOR PLANS

FLOOR PLAN HVAC GRAPHICS

- **Base Bid**: Individual floor plan pages shall include a custom two-dimensional graphic of the individual floor displaying room names. The floor plans shall be based off of the AutoCAD files provided as Exhibit 3.

- **Add Alternate Bid**: Individual floor plan pages shall include a custom three-dimensional graphic of the individual floor displaying doorways, shading, and room names. The floor plans shall be rendered by the IAS Installation Contractor to the detail shown below using Autodesk 3ds Max 3D rendering software, or equivalent.

- Each enlarged floor plan shall display color overlays to indicate individual HVAC zones.

- Display dynamic gradient coloring/shading of each zone based on a user selected variable. At a minimum, provide the following variable display choices:
  - “Temperature” – Display zone temperature (Deg F)
  - “Setpoints” – Display zone temperature deviation from setpoint (Deg F)
  - “Heat/Cool Demand” – Display the zone % heating/cooling command (%)
  - “Discharge” – Display the zone current discharge air temperature (Deg F)

- Provide a Playback button to display a video of historic conditions for the selected variable in display.

- A sample floor plan section HVAC graphic page shown below:

  ![Floor Plan Graphic](image)

Specific Requirements:

1) User drop down selection for color gradient variable
2) On mouse-over, a pop up window shall display zone name, space temperature and setpoint. Clicking on a zone shall navigate the user to the HVAC graphic of the system serving the zone.
3) Provide room names within the floor plans.
ALARM MANAGEMENT GRAPHICS PAGE

- At minimum each individual building and campus (if there multiple MCCCD facilities onsite) shall contain an Alarm Page (all alarms)
- A sample alarm management graphic page shown below:

Specific Requirements:

1) Provide user selection for the date range of alarms to display.
2) Provide alarm filters. At a minimum, allow the user to filter alarms by Alarm Class, Priority, State, and Acknowledged State.
3) Provide a graph timeline of the alarm status within the selected timeframe.
4) Provide alarm details including alarm state, message, priority, user, user notes, and ack status.
5) Provide selections to allow the user to perform acknowledgement of multiple alarms by category or filtered view.
FAULT DETECTION AND DIAGNOSTIC GRAPHIC OVERVIEW

- At minimum each individual building shall contain a Fault Detection and Diagnostic Overview Page.
- A sample fault detection and diagnostic graphic page is shown below:

Specific Requirements:

1) Data selection time range.
2) Provide active faults with associated energy costs, timeframes, and messages
3) Provide a menu of facility equipment to display.
4) Provide applicable trends of fault variables.
GENERAL REQUIREMENTS

HVAC system graphics shall have the following common features and displays.

Specific Requirements:

1) Indicate the HVAC system name.
2) Label all points according to the IAS drawing object name abbreviation. On mouse-over, the point’s written English object description shall pop-up.
3) Provide user selection for “Device Info” and “Graphic” views. The Device Info requirements are shown on the next page.
4) Provide user selection for views of each HVAC system’s trend views.
5) Provide a playback feature which shows a video of historic data points over a user selected time period.
**Device Info View**

Program and display the following properties for each BACnet network device.

<table>
<thead>
<tr>
<th>BACNET PROPERTY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object_Identifier</td>
<td>Identify BACnet Device Instance</td>
</tr>
<tr>
<td>Object_Name</td>
<td>Identify IAS HVAC System Name</td>
</tr>
<tr>
<td>Object_Type</td>
<td>Identify BACnet Object Type</td>
</tr>
<tr>
<td>System_Status</td>
<td>Multistate Device Point</td>
</tr>
<tr>
<td>Vendor_Name</td>
<td>Identify Controller Manufacturer</td>
</tr>
<tr>
<td>Vendor_Identifier</td>
<td>Identify BACnet Vendor ID</td>
</tr>
<tr>
<td>Model_Name</td>
<td>Identify Vendor’s Model Name</td>
</tr>
<tr>
<td>Firmware_Revision</td>
<td>Use Vendor’s Firmware Revision</td>
</tr>
<tr>
<td>Application_Software_Version</td>
<td>Use Vendor’s Version #</td>
</tr>
<tr>
<td>Location</td>
<td>Identify Room Location.</td>
</tr>
<tr>
<td>Description</td>
<td>Identify the JACE Network that the Device is Placed On.</td>
</tr>
</tbody>
</table>
1.0 GENERAL

1.1 PURPOSE AND SCOPE

This Guideline provides requirements for data modeling of building systems and equipment based on the Project Haystack open source data modeling standard. The purpose is to provide a consistent, standardized methodology for describing data points associated with DDC automation systems and their associated descriptive information known as metadata or data semantics. The intent of this Point Tagging Guideline is to build the DDC database of points and tags in a common vocabulary that can be interpreted automatically by a variety of software and web based applications. The District’s goals are as follows:

- To enable owners, operators, and service providers to more efficiently derive value from the vast amounts of data the DDC systems are collecting and
- To eliminate the need for manual mapping of points from one application to another over the lifetime of the DDC network.

1.2 BACKGROUND

Modern automation systems and smart devices have made it easy to collect significant quantities of data including environmental conditions, equipment operational status, and energy usage and performance. This data typically exists in unstructured formats without standard or consistent organization, making it difficult for anyone but the service technician to interpret trends, perform analysis, or identify potential faults without significant manual effort.

The first step to turning smart device data into actionable intelligence is to give the data context to define exactly what each piece of data means and how fits into an overall system. This requires descriptions of each point’s type, units, associated system type, equipment parent/child relationship, controller and network information, and physical locations. In today’s complex systems, it is not possible to capture the full extent of descriptive information desired simply using data point names, even if standardized. Point names that attempted to capture this range of information would be impossibly long, therefore structured combinations are needed.

In order to capture the semantic data required for automatic software point recognition, DDC network data shall be configured using all applicable Project Haystack tag definitions available at the time of installation. Project Haystack is an open source, community-driven initiative modeled on the open source specifications found in the software and IT industry. There is future work to integrate Haystack tags with BACnet XD extended data. Project Haystack encompasses the following elements:

- A data modeling methodology
- A library of published tagging libraries
- A REST communication protocol designed to exchange Haystack tags between applications.
- An assortment of complementary software applications developed by various Haystack community members including:
  - Haystack Java Tookit
  - Niagara NHaystack Module
  - Haystack CPP
  - Haystack Dart Client Library
  - NodeHaystack

1.3 APPLICABLE POLICIES, STANDARDS, AND PROCEDURES

Project Haystack
Guide Specification for Data Modeling of Building Systems and Equipment
Version 2013-10-1
Project Haystack
2.0 TECHNICAL OVERVIEW

2.1 TAGS

The Project Haystack data modeling standard for Buildings and Equipment systems shall use a simple metamodel based on the concept of “tags” as described below.

**Tags:** Tags are name/value pairs, associated with entities like air handling units, electric meters, etc. Tags are simple and dynamic, add structure, and provide the flexibility needed to establish standardized models of diverse systems and equipment. Tags are a modeling technique that allows easy customization of data models on a per-task, per-project or per-equipment basis, while retaining the ability to be interpreted by external applications using a standard, defined methodology and vocabulary. Tags shall support the definition of the following essential data elements:

- **Entity:** An Entity is an abstraction for a physical object in the real world. Entities include sites, facilities, equipment, sensor points, weather stations, etc. In software systems, an entity might be modeled as a record in a database, an object in a building automation system, or a row in a csv file or spreadsheet.
- **Id:** The id tag is used to model the unique identifier of an entity in a system using a Ref value type. For the DDC network, the id tag shall be the unique DDC point name as defined in Guideline 9. This identifier may be used by other entities to cross-reference entities, associations, and systems.
- **Dis:** The dis tag is used with entities to define display text used to describe an entity. Dis values are intended to be short (less than 30 or 40 characters), but fully descriptive of the entity for a human user. For the DDC network, the dis tag shall be identical to the point description on the DDC Points List.

**Tag Kinds** – The Project Haystack standard provides the following permitted tag value types:

- **Marker:** this tag type is merely a marker annotation with no meaningful value. Marker tags are used to indicate a "type" or "is-a" relationship.
- **Bool:** boolean "true" or "false".
- **Number:** integer or floating point number annotated with a Unit of Measurement, where units of measure are prescribed for various tasks.
- **Str:** a string of Unicode characters.
- **Uri:** a Universal Resource Identifier.
- **Ref:** reference to another entity. The Project Haystack specification does not currently prescribe specific identities or reference mechanisms, but shall be used to cross link entities. Refs are formatted with a leading "@" and require a specific subset of ASCII characters be used: a-z, A-Z, 0-9, underbar, colon, dash, or dot.
- **Bin:** a binary blob with a MIME type formatted as Bin(text/plain)
- **Date:** an ISO 8601 date as year, month, day: 2011-06-07.
- **Time:** an ISO 8601 time as hour, minute, seconds: 09:51:27.354.
- **DateTime:** an ISO 8601 timestamp followed by timezone name:
  - 2011-06-07T09:51:27-04:00 New_York
  - 2012-09-29T14:56:18.277Z UTC

**Tag Database** – The Project Haystack standard continuously updates and incorporates new tags into its database. The DDC Installation Contractor shall download the Project Haystack Tags Database at the beginning of each project to ensure that the most up to date relevant tags are incorporated within the project. The Tags Database can be downloaded in the Project Haystack Download page in the following link:

Project-haystack.org/download
2.2 DDC NIAGARA MODULES

The Project Haystack Community has developed, and makes available, a comprehensive implementation of the Haystack protocol in the form of a software module for use with Niagara-based systems. The module, known as NHaystack, is licensed under the Academic Free License (“AFL”) v. 3.0. Public access to the NHaystack software module is maintained via the project-haystack.org site. The NHaystack module shall be the preferred method of communication between the Niagara-based devices and other software applications that are consuming Niagara data or writing commands back to Niagara-based systems.

3.0 MINIMUM MODEL REQUIREMENTS

3.1 TAGGING REQUIREMENTS OVERVIEW

The goal of the Project Haystack data modeling standard is to ensure consistent modeling of building systems, devices and associated data. The following DDC application requirements outline the use of the modeling standard in applications related to buildings, energy, and facility management.

The tags identified in Section 3 shall be applied to all integrated system types in MiraCosta’s DDC network.

3.2 POINT TAGGING

Including standardized associations with sites and equipment via id reference, units of measure as a minimum. Where possible, ranges of acceptable values are required.

Points are typically a digital or analog sensor or actuator entity (hard-wired points). Points can also represent a configuration value such as a setpoint or schedule log (virtual or network points). Point entities are tagged with the point tag.

Point Kinds:

All points shall be classified as Bool, Number, or Str using the kind tag:

- **Bool**: model digital points as true/false. Bool points may also define an enum tag for the text to use for the true/false states
- **Number**: model analog points such as temperature or pressure. These points shall also include the unit to indicate the point's unit of measurement.
- **Str**: models: an enumerated point with a mode such as "Off, Slow, Fast". Enumeraed points shall also define an enum tag.

Point Min/Max:

The following tags shall be used to define a minimum and/or maximum for the point:

- **minVal**: minimum point value
- **maxVal**: maximum point value

When these tags are applied to a sensor point, they model the range of values the sensor can read and report. Values outside of these range shall indicate a fault condition in the sensor.

When these tags are applied to a cmd or sp, they model the range of valid user inputs when commanding the point.
**Point Cur:**

The term *cur* indicates synchronization of a point's current real-time value. This typically indicates refresh rates within the order of a few seconds. If a point supports a current or live real-time value then it shall be tagged with *cur* tag.

The following tags are used to model the current value and status:

- **curVal**: current value of the point as Number, Bool, or Str
- **curStatus**: ok, down, fault, disabled, or unknown
- **curErr**: error message if curStatus indicated error

**Point Write**

Writable points are points which model an output or setpoint and may be commanded. Writable points are modeled on the BACnet 16-level priority array with a relinquish default which effectively acts as level 17. Writable points which may be commanded by the pointWrite operation shall be tagged with the writable tag.

The following levels have special behavior:

- **Level 1**: highest priority reserved for emergency overrides
- **Level 8**: manual override with ability to set timer to expire back to auto
- **Default**: implicitly acts as level 17 for relinquish default

Refer to Guideline 3 – HVAC Control BACnet Field Level Network Guidelines, Section 4.4 Command Priorities for details on BACnet priority levels.

The priority array provides for contention resolution when many different control applications may be vying for control of a given point. Low level applications like scheduling typically control levels 14, 15, or 16. Then users can override at level 8. But at higher levels like 2 to 7 can be used to trump a user override (for example a demand response energy routine that requires higher priority).

The actual value to write is resolved by starting at level 1 and working down to relinquish default to find the first non-null value. It is possible for all levels to be null, in which case the overall write output is null (which in turn may be auto/null to another system). Anytime a null value is written to a priority level, the level has been set to auto or released (this allows the next highest level to take command of the output).

The following tags are used to model the writable state of a point:

- **writeVal**: this is the current "winning" value of the priority array, or if this tag is missing then the winning value is null
- **writeLevel**: number from 1 to 17 indicate the winning priority array level
- **writeStatus**: status of the server's ability to write the last value to the output device: ok, disabled, down, fault.
- **writeErr**: indicates the error message if writeStatus is error condition

**Point His**

If a point is *historized* this means that it has a time-series sampling of the point's value over a time range. Historized points are sometimes called *logged* or *trended* points. Historized points shall be tagged with the his tag.

If a point implements the his tag, then it shall also implement these tags:

- **tz**: all historized points must define this tag with their timezone name (must match the point's site timezone)
- **hisInterpolate**: optionally defined to indicate whether the point is logged by interval of change-of-value
- **hisTotalized**: optionally defined to indicate a point is collected an ongoing accumulated value

The current status of historization shall be modeled with:
### 3.3 NETWORK TAGGING

The following diagram illustrates how devices, networks, and communication connections between devices are modeled:

#### Devices

The device tag models a physical device. Devices include servers, area controllers, field controllers, etc.

#### Networks

The network tag models a network. Networks tags shall be used to setup logical connections between devices.

#### Connections

Device-to-device communication shall be modeled using a connection with the following tags:

- **connection**: marker tag
- **protocol**: string enumeration communications protocol
- **device1Ref**: first device end point
- **device2Ref**: second device end point
- **networkRef**: network used for the communication

If a device sits "higher" in the network architecture, then it shall be tagged with device1Ref. For example, given a connection between a server and area controller, then the server shall be device1Ref and the area controller shall be device2Ref.
3.4 EQUIPMENT TAGGING

Equipment is modeled using the equip tag. Equipment is often a physical asset such as an AHU, boiler, or chiller. However, equip can also be used to model a logical grouping such as a chiller plant. All equipment shall be associated within a single site using the siteRef tag. In turn, equipment will often contain points which are associated with the equipment via the equipRef tag.

Here is an example of an AHU equipment entity:

```
id: @MCCCD.ahuG11A1B
dis: "MCCCD AHU-G1 1A/1B"
equip
siteRef: @MCCCD.BLDG1
ahu
```

The equipRef tag can optionally be used on equip entities to model nested equipment and containment relationships.

**Chiller Plants**

A chiller plant is composed of multiple pieces of equipment used to generate chilled water. The entire plant is modeled as an equip with its own plant-level points. Sub-equipment such as chillers and cooling towers are also modeled as equip contained by the plant via the equipRef tag.

The follow diagram shows the terminology used for logical flow of water through a chiller plant:

![Diagram of Chiller Plant Terminology]

Note that the terminology for sensors/setpoints are based on the perspective of the equipment. The condenser water *leaving* the chiller, is the condenser water *entering* the cooling tower.

Model the entire plant using the chillerPlant tag. The plant is modeled as an equip and it will define its own plant level points:

Chilled water to/from AHUs

- chilled water leaving temp sensor
- chilled water leaving temp sp
- chilled water leaving flow sensor
- chilled water leaving pressure sensor
- chilled water entering temp sensor
- chilled water entering flow sensor
- chilled water entering pressure sensor
- chilled water delta temp sensor
- chilled water delta flow sensor
- chilled water delta pressure sensor
- chilled water delta pressure sp
• chilled water bypass valve cmd
Condenser water between Chillers/Cooling Towers
  • condenser water delta pressure sensor
  • condenser water bypass valve cmd
Note: not every combination of sp is listed, just most common setpoints.
Also define the following tags for pipework and its associated equip and points:
  • primaryLoop: pipework within the chiller plant
  • secondaryLoop: pipework from the chiller plant to the building

Chillers

Chiller equips are marked with the chiller tag. Equip level tags:
  • equipRef must reference parent chillerPlant if associated with a plant
  • waterCooled or airCooled
  • absorption or if vapor compression: reciprocal, screw, or centrifugal
  • coolingCapacity
Points associated with chiller equip:
Run/Status
  • run cmd
  • run sensor
  • enable cmd
  • load cmd
  • load sensor
  • efficiency sensor
  • power sensor
  • energy sensor
Chilled water to/from AHUs
  • chilled water leaving temp sensor
  • chilled water leaving temp sp
  • chilled water leaving flow sensor
  • chilled water leaving pressure sensor
  • chilled water entering temp sensor
  • chilled water entering flow sensor
  • chilled water entering pressure sensor
  • chilled water delta temp sensor
  • chilled water delta flow sensor
  • chilled water delta pressure sensor
  • chilled water valve isolation cmd
Condenser water to/from cooling towers
  • condenser water leaving temp sensor
  • condenser water leaving flow sensor
  • condenser water leaving pressure sensor
  • condenser water entering temp sensor
  • condenser water entering pressure sensor
  • condenser water entering flow sensor
  • condenser water valve isolation cmd
Misc Internal
  • condenser cmd
  • condenser refrig temp sensor
- condenser refrigeration pressure sensor
- evaporator refrigeration temp sensor
- evaporator refrigeration pressure sensor

Note: not every combination of sp is listed, just most common setpoints. Chillers share the same point modeling conventions as VFDs. Chillers which measure energy shall model their points using the same conventions as elec meters or thermal meters.

**Cooling Towers**

Cooling towers are marked with the coolingTower tag. Equip level tags:

- equipRef must reference parent chillerPlant if associated with a plant
- openLoop or closedLoop

Points associated with cooling tower equip:

- condenser water leaving temp sensor
- condenser water leaving temp sp
- condenser water leaving flow sensor
- condenser water leaving pressure sensor
- condenser water entering temp sensor
- condenser water entering pressure sensor
- condenser water entering flow sensor
- fan cmd
- fan sensor

**Heat Exchangers**

Heat exchangers are tagged with heatExchanger. Equip level tags:

- equipRef must reference parent chillerPlant if associated with a plant

Points associated with heat exchanger equip:

- chilled water leaving temp sensor
- chilled water entering temp sensor
- condenser water leaving temp sensor
- condenser water entering flow sensor

**Boilers**

Boiler

- The boiler tag is used to model boiler assets.

Boiler Plant

- The boilerPlant tag is used to group one or more boilers.

**Air Handling Units**

**Overview**

The ahu tag is used to model air handling equipment designed to heat or cool air. In Project Haystack, packaged rooftop units are considered a special class of AHU. Packaged units use the ahu tag, but shall also specify the rooftop tag:

- Ahu //any type of air handler unit (built-up or RTU)
- Ahu and rooftop //only packaged rooftop units (RTU's)
- Ahu and not rooftop //only built-up custom AHU's
Tags
AHUs shall always be marked as ahu and equip. The following tags are also used:

- **hvac**: always specified to mark as an HVAC asset
- **rooftop**: if the AHU is a packaged rooftop unit (RTU)
- **boilerPlantRef**: to associate the AHU with the boiler plant supplying its hot water or steam
- **chillerPlantRef**: to associate the AHU with the chiller plant supplying its chilled water

Heating and Cooling Method

AHUs shall define their heating method using one of the following tags:

- **elecHeat**
- **hotWaterHeat**
- **steamHeat**
- **gasHeat**

Cooling method shall be defined using one of the following tags:

- **chilledWaterCool**
- **dxCool**

Constant vs Variable Volume

An AHU shall be tagged as either **constantVolume** or **variableVolume** based on its ability to adjust the volume of air flow. Typically this distinction is based on whether the AHU’s fan is single speed or a VFD.

Zone Delivery

The following tags define the system used to deliver air to the zones:

- **directZone**: AHU supplies air directly to the zone
- **vavZone**: AHU supplies air to VAV terminal units
- **chilledBeamZone**: AHU supplies air to chilled beam terminal units
- **multiZone**: air is split into a duct per zone

A Variable Volume Temperature or VVT system is defined as a constant volume AHU with VAV terminal units. This is indicated by the presence of both the **constantVolume** and **vavZone** tags.

Ductwork

In multi-duct systems, the AHU discharges into multiple ducts for simultaneous cooling, heating, or neutral air:

- **singleDuct**: AHU uses a single duct
- **dualDuct**: the AHU discharges to two ducts which is some combination of hotDeck, coldDeck, or neutralDeck
- **tripleDuct**: the AHU discharges into three ducts which are the hotDeck, coldDeck, and neutralDeck

Sections

Most points in an AHU are associated with one of the following sections of the unit:

- **discharge**: air exiting the unit to be supplied to the zones/terminal units
- **return**: air returning from the zone back into the unit
- **outside**: fresh, outside air entering the unit for air quality and economizing
exhaust: air exiting the unit back outside
mixed: return and outside air mixed together before passing through the heating/cooling elements
cool: cooling elements/ coils
heat: heating elements/ coils
zone: conditioned space associated with the unit

The follow diagram shows the logical flow of air through an AHU:

Points

The following lists points commonly used with an AHU:
Discharge
- discharge air temp sensor
- discharge air humidity sensor
- discharge air pressure sensor
- discharge air flow sensor
- discharge air fan cmd
- discharge air fan sensor

Return
- return air temp sensor
- return air humidity sensor
- return air pressure sensor
- return air flow sensor
- return air co2 sensor
- return air fan cmd
- return air damper cmd

Mixed
- mixed air temp sensor

Outside
- outside air temp sensor
- outside air humidity sensor
- outside air pressure sensor
- outside air flow sensor
- outside air flow sp
- outside air damper cmd

Exhaust
- exhaust air fan cmd
- exhaust air damper cmd

Conditioning
- cool stage cmd
- heat stage cmd
• humidifier cmd
• filter sensor

**VAV terminal air units**

The vav tag is used to model variable air volume assets. VAVs shall always be marked as equip.

**Tags**

VAVs shall be classified with the following type tags:

- coolOnly
- series fanPowered elecReheat
- series fanPowered hotWaterReheat
- parallel fanPowered elecReheat
- parallel fanPowered hotWaterReheat

The additional equip level tags are defined for VAVs:

- **hvac**: always specified to mark as an HVAC asset
- **singleDuct or dualDuct**: ductwork configuration
- **ahuRef**: supply AHU
- **chillerPlantRef**: plant supplying chilled water if applicable
- **boilerPlantRef**: plant supplying hot water if applicable
- **pressureDependent or pressureIndependent**: control based on duct static pressure

**Sections**

We associate points with sections of a VAV using these tags:

- **entering**: air entering the unit from the AHU
- **discharge**: air exiting the unit to be supplied to the zones
- **zone**: conditioned space associated with the unit

**Points**

VAVs points include zone points:

- zone air temp sensor
- zone air temp effective sp
- zone air temp occ cooling sp
- zone air temp occ heating sp
- zone air temp unocc cooling sp
- zone air temp unocc heating sp
- zone air temp standby cooling sp
- zone air temp standby heating sp
- zone air humidity sensor
- zone air co2 sensor
- zone air co2 sp

Other standardized points:

- discharge air temp sensor
- discharge air pressure sensor
- discharge air flow sensor
- discharge air flow effective sp
- discharge air flow min sp
- discharge air flow max sp
- discharge air flow reheating max sp
- discharge air flow standby sp
- discharge air fan cmd
- discharge air fan sensor
- discharge air damper cmd
- entering air temp sensor
- reheat cmd
- vavMode sp
- ductArea sp

**Fan Coil Units**

The fcu tag is used to model fan coil units. Fan coils are unitary equipment which use zone itself for supply air.

FCUs shall define their cooling/heating method using AHU conventions.

FCUs shall following model of AHU points

**Units Ventilators**

The uv tag is used to model unit ventilators. Unit ventilators differ from FCUs in that they have direct access to outside air.

UVs shall define their cooling/heating method using AHU conventions.

UVs shall following model of AHU points

**Heat Pumps**

The heatPump tag is used to model heat pumps.

**Variable Frequency Drives**

The standardized points for VFDs are:

- run cmd
- run sensor
- enable cmd
- speed cmd
- freq cmd

The primary on/off point of equipment is always modeled with the run tag. Paired with cmd it models the on/off command point; paired with sensor it models the run status point. Many VFDs also include a secondary enable point which requires both run and enable to be commanded to true in order for the equipment to be on.

Speed of the VFD is commanded separately via the speed or freq point. Use of these points require that the equipment has already been commanded on.

Many VFDs will also provide many of the same points as an electric meter. Measurements such as electric demand, consumption, voltage, and current shall follow the same conventions as elec meters:

- power sensor
- energy sensor
- current sensor
- current phase sensor
- volt sensor
- volt phase sensor
- pf sensor
- pf phase sensor
Pumps

Pumps are required to be modeled as equip entities with the pump tag. If the pump motor is a VFD then it shall also define the vfd tag and model its points using the standard VFD conventions discussed above. Simple non-VFD pumps shall model their on/off state via a run point.

Fans

Fans may optionally be defined as either an equip or a point. If the fan motor is a VFD then it is recommended to make the fan a sub-equip. However in many cases a simple fan in a terminal unit such as a vav is better modeled as a point.

Fan Points

In simple cases where the fan is just a command and/or feedback sensor then it is best to model it as a point.
If annotated as an output with the cmd tag, then the point models the command status of the fan:
false (off) or true (on)
variable speed then it is 0% (off) to 100% (full speed)
If annotated as an input with the sensor tag, then the point models a sensor used to verify if the fan status:
false indicated no air flow (off) or true indicates successful airflow (fan is on)
if numeric the point is differential pressure across the fan measured in "inH₂O" or "kPa"

3.5 SITE TAGGING

Zones

The zone tag is used for points associated with a conditioned space in a building. Zone points are used consistently by any equipment used to condition the space including:

- directZone ahu
- vav
- fcu
- uv
- heatPump

Zone Points

The following are the standardized zone points:

- zone air temp sensor
- zone air temp effective sp
- zone air temp occ cooling sp
- zone air temp occ heating sp
- zone air temp unocc cooling sp
- zone air temp unocc heating sp
- zone air temp standby cooling sp
- zone air temp standby heating sp
- zone air humidity sensor
- zone air co2 sensor
- zone air co2 sp
Sites

A site entity models a single facility using the site tag. For example a campus is better modeled with each building as a site, versus treating the entire campus as one site.

Core tags used with sites:

- **geoAddr**: the geographic free-form address of the site (which might include other geolocation tags such as geoCity or geoCoord)
- **tz**: the timezone where the site is located
- **area**: square footage or square meters of the facility. This enables site normalization by area.
- **weatherRef**: associate the site with a weather station to visualize weather conditions and perform weather based energy normalization
- **primaryFunction**: enumerated string which describes the primary function of the building
- **yearBuilt**: four digit year in which the building was constructed

Weather

Building operations and energy usage are heavily influenced by weather conditions. This makes modeling of weather data a critical feature of Project Haystack. Because weather stations and measurements are often shared across multiple buildings, weather is not modeled as part of a site. Rather the weather tag models a separate top-level entity which represents a weather station or logical grouping of weather observations.

All weather entities shall define a tz tag. Optionally they can also define geolocation tags such as geoCountry, geoCity, and geoCoord.

Weather Points

Weather data follows the same conventions as points, but to indicate that they associated with a weather entity, and not a site entity, we use the special tag weatherPoint to indicate a weather related point.

The following weather points are defined by the standard library:

- **weatherCond**: enumeration of conditions (clear, cloudy, raining)
- **air temp**: dry bulb outside temperature in °C or °F
- **wetBulb** temp: web bulb outside temperature in °C or °F
- **humidity**: percent humidity
- **sunrise**: historized trend of sunrise/sunsets as true/false transitions

Weather points are associated with their weather entity using the weatherRef tag. In Haystack, weather station data is annotated with weatherPoint and site-local sensors with outside:

- weatherPoint temp versus outside temp
- weatherPoint humidity versus outside humidity