MiraCosta College San Elijo Campus

San Elijo B400

3333 Manchester Avenue, Cardiff, CA 92007



PROJECT MANUAL

FOR

MCCCD, San Elijo Campus B400
Science Lab Modernization

100% CDS ubmittal Set

January 15, 2021

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 04-119580 INC:
REVIEWED FOR
SS ☑ FLS ☑ ACS ☑
DATE: 02/02/2021

Project No.
January 15, 2021

B400Renovation Science Building
MiraCosta San Elijo College

ARCHITECT

HPI Architecture
115 22nd Street
Newport Beach, CA 92663
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Contact: **Lawrence A. Frapwell, Principal**



LANDSCAPE

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San Diego, CA 92103
P: (858) 751-0633

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Cheri Blatner-Pifer
Amy Hoffman



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Sean Drake



SURVEY

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MHP Structural Engineers
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P: (562) 985-3200

Contact: **Ken O'dell, Principal**
Matt Wexler, Manager



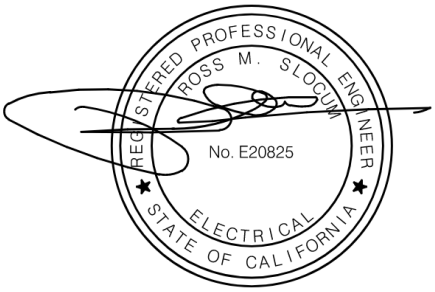
MECHANICAL



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9665 Chesapeake, Suite 230
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Contact: **James Del Monaco**
Yoni Butbul

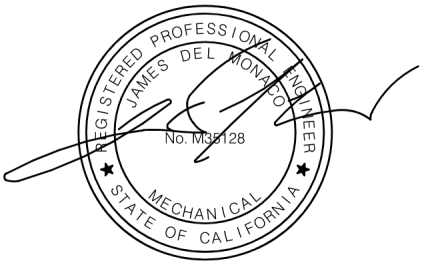
ELECTRICAL



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Miriam Pinzon-Betancourt

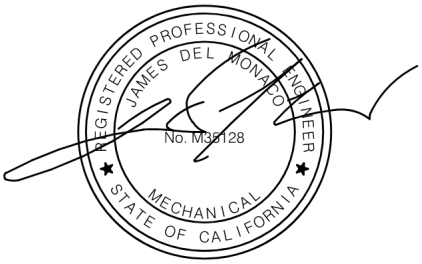
PLUMBING



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FIRE SPRINKLER



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Quang Nguyen

HVAC HORIZONTAL



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SECURITY CONSULTANT



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P: (858) 846-0333

Contact: **Edward Wong**
Jason Thomborough

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work includes the renovation of the B400 Building on MiraCosta College's San Elijo Campus. As follows:

1. Complete interior renovation of a Biology Lab, Physical Science Lab, and General-Purpose lab, Lab prep, Offices, Study Space.
2. Site Improvements to address accessibility issues and provide new hardscape and landscape.
3. Exterior improvements are limited to the replacement of windows, doors, roofing, and paint.
4. Voluntary Seismic Upgrade.

B. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished products.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.

C. Related Section:

1. Division I Section "Temporary Facilities And Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.03 PROJECTION INFORMATION

A. Project Identification: MiraCosta San Eljio B400 Science Lab Modernization.

1. Project Location: 3333 Manchester Avenue, Cardiff, CA 92007

B. Owner: MiraCosta Community College District, 1 Barnard Dr., Oceanside, CA 92056
Phone: (760) 795-6691

C. Owner's Representative: Ed Dajani – Campus Manager - Kitchell
Phone: (619) 851-7718

D. Architect: Hill Partnership Inc., AKA HPI Architecture

1. Architect's representative: TBD.

1.04 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents.

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

1.05 OWNER-FURNISHED, CONTRACTOR INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated on Drawings as OFCI and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt

C. Relocation of Owner's existing equipment and products indicated as OFCI (Owner Furnished Contractor Installed) equipment, Contractor is responsible for removing existing equipment from its original location, including the work to uninstall the equipment, remove anchorage, etc. When relocating Owner's existing equipment in its new location, the Contractor shall reinstall / attach the equipment to match how it was placed or attached in it's previous condition to achieve the college's intended use for the equipment.

1.06 ACCESS TO SITE

A. 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. Contractor to coordinate with the BMT on site access.

1. Limits: Confine construction operations to areas indicated on Drawings.

2. Driveways, Walkways and Entrances: Keep driveways 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 storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances by construction operations and prevent disruption to the District, especially during exam times.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
    c. All deliveries through public spaces, including parking lots, should be escorted to and from the site by two (2) flag men at the front and rear of the vehicle.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather tight condition throughout construction period. Repair damage caused by construction operations.

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.

1.07 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner shall have access to the site and adjacent building(s) during the 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 the Owner not less than 72 hours in advance of activities that will affect Owner's operations. Refer to the General Conditions for a list of notification time-frames.

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 Certification 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, inspections and commissioning 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.

1.08 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction. Contractor to be especially aware to the Districts academic calendar and ensure no disruption to exam times or any other special events by the District, times and dates for which have not yet been identified.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated.

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 Owner's Representative no less than a minimum two (2) weeks of proposed utility interruptions.
2. Obtain Owner's Representative written permission before proceeding with utility interruptions.
3. All Utilities cutovers should be performed after-hours or during weekends, unless otherwise indicated.

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 Owner's Representative no less than a minimum one (1) week in advance of proposed disruptive operations.
2. Obtain Owner's Representative written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the construction site building or on campus except for designated smoking areas.

F. Controlled Substances: Use of tobacco products and other controlled substances on the College Campus is not permitted.

G. Employee Identification: Provide identification tags for personnel working on the Project site. Require personnel to utilize identification tags at all times.

H. Employee Screening: Comply with Owner's requirements regarding drugs and background screening of Contractor personnel working on the Project site. Maintain list of approved screened personnel with Owner's Representative.

1.09 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 1 General Requirements: Requirements of Section in Division 1 apply to the Work of all Sections in the Specifications.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

DOCUMENT 01 25 13
PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.01 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.

1.02 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT

A. The Board of Trustees has made certain findings and approved specific materials, products, systems, services, and/or things pursuant to the exception found in Public Contract Code section 3400 (c) (2). The specific materials, products, systems, services, and/or things are all set forth in the Resolutions passed by the Board of Trustees. A list of those specific materials, products, systems, services, and/or things are included here: http://www.miracosta.edu/administrative/purchasing/measuremmbids.html

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 DOCUMENT

DOCUMENT 01 26 00

CHANGES IN THE WORK

CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE PROVISIONS IN THE AGREEMENT, GENERAL CONDITIONS, AND SPECIAL CONDITIONS, IF USED, RELATED TO CHANGES AND/OR REQUESTS FOR CHANGES. SEE ATTACHED FORM FOR CHANGE ORDER REQUESTS (CORs).

CHANGE ORDER REQUEST FORM

MiraCosta Community College District
1 Barnard Drive
Oceanside, CA 92056

COR NO.:

Project:
Bid No.:
RFI #:

Date:
DSA File No.:
DSA Appl. No.:

Contractor hereby submits for District's review and evaluation this Change Order Request ("COR"), submitted in accordance with and subject to the terms of the Contract Documents, including Article 42 of the General Conditions. Any spaces left blank below are deemed no change to cost or time.

Contractor understands and acknowledges that documentation supporting Contractor's COR must be attached and included for District review and evaluation. Contractor further understands and acknowledges that failure to include documentation sufficient to, in District's discretion, support some or all of the COR, shall result in a rejected COR.

	WORK PERFORMED OTHER THAN BY CONTRACTOR	**ADD**	**DEDUCT**
(a)	**Material** (attach suppliers' invoice or itemized quantity and unit cost plus sales tax)		
(b)	**Add Labor** (attach itemized hours and rates, fully encumbered)		
(c)	**Add Equipment** (attach suppliers' invoice)		
(d)	**Subtotal**		
(e)	**Add Allowable Markup for any and all tiers of Subcontractor**, per Article 42 of General Conditions of Item (d)		
(f)	**Subtotal**		
(g)	**Add Allowable Markup for Contractor**, per Article 42 of General Conditions of Item (f)		
(h)	**Subtotal**		
(i)	**Add Bond and Insurance**, per Article 42 of General Conditions of Item (h)		
(j)	**TOTAL**		
(k)	**Time** (zero unless indicated; "TBD" not permitted)	____ **Calendar Days**	

[REMAINDER OF PAGE LEFT BLANK INTENTIONALLY]

	WORK PERFORMED BY CONTRACTOR	**ADD**	**DEDUCT**
(a)	**Material** (attach itemized quantity and unit cost plus sales tax)		
(b)	**Add Labor** (attach itemized hours and rates, fully encumbered)		
(c)	**Add Equipment** (attach suppliers' invoice)		
(d)	**Subtotal**		
(e)	**Add Allowable Markup for Contractor**, per Article 42 of General Conditions of Item (d)		
(f)	**Subtotal**		
(g)	**Add Bond and Insurance**, per Article 42 of General Conditions of Item (f)		
(h)	**TOTAL**		
(i)	**Time** (zero unless indicated; "TBD" not permitted)	____ **Calendar Days**	

The undersigned Contractor approves the foregoing as to the changes, if any, to the Contract Price specified for each item, and as to the extension of time allowed, if any, for completion of the entire Work as stated herein, and agrees to furnish all labor, materials, and service, and perform all work necessary to complete any additional work specified for the consideration stated herein. Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650 *et seq*. It is understood that the changes herein to the Contract shall only be effective when approved by the governing board of the District.

It is expressly understood that the value of the extra Work or changes expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

SUBMITTED BY:

Contractor:

_____ _____

[Name] Date

END OF DOCUMENT

DOCUMENT 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: _____

DOCUMENT 01 31 19

PROJECT MEETINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions; and

B. Special Conditions.

1.02 PROGRESS MEETINGS:

A. PMO shall schedule and hold regular weekly progress meetings after a minimum of one week's prior written notice of the meeting date and time to all Invitees as indicated below.

B. Location: PMO's field office.

C. The Contractor shall notify and invite the following entities (“Invitees”):

(1) District Representative.

(2) Contractor.

(3) Contractor's Project Manager.

(4) Contractor's Superintendent.

(5) Subcontractors, as appropriate to the agenda of the meeting.

(6) Suppliers, as appropriate to the agenda of the meeting.

(7) Construction Manager, if any.

(8) Architect

(9) Engineer(s), if any and as appropriate to the agenda of the meeting.

(10) Others, as appropriate to the agenda of the meeting.

D. The District's, the Architect's, and/or an engineer's Consultants will attend at their discretion, in response to the agenda.

E. The District representative, the PMO, and/or another District Agent shall take and distribute meeting notes to attendees and other concerned parties. If exceptions are taken to anything in the meeting notes, those exceptions shall be stated in writing to the District within five (5) working days following District's distribution of the meeting notes.

1.03 PRE-INSTALLATION/PERFORMANCE MEETING:

A. Contractor shall schedule a meeting prior to the start of each of the following portions of the Work: cutting and patching of plaster and roofing, and other weather-exposed and moisture-resistant products. Contractor shall invite all Invitees to this meeting, and others whose work may affect or be affected by the quality of the cutting and patching work.

B. Contractor shall review in detail prior to this meeting, the manufacturer's requirements and specifications, applicable portions of the Contract Documents, Shop Drawings, and other submittals, and other related work. At this meeting, invitees shall review and resolve conflicts, incompatibilities, or inadequacies discovered or anticipated.

C. Contractor shall review in detail Project conditions, schedule, requirements for performance, application, installation, and quality of completed Work, and protection of adjacent Work and property.

D. Contractor shall review in detail means of protecting the completed Work during the remainder of the construction period.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 31 50

CONTRACTOR'S REQUEST FOR INFORMATION

PART 1 - GENERAL

1.01 SUMMARY

This section covers general requirements for Contractor's Requests for Information (RFI).

A. The Contractor will use Prolog Converge to prepare and submit requests for information unless otherwise instructed by the District.

B. Related Sections:

(1) General and Supplementary Conditions for changes in the Work.

(2) Section 01 31 19: Progress Meetings

(3) Section 01 33 00: Submittals

1.02 RFI'S

A. Submit a Request for Information to the District when:

(1) An unforeseen condition occurs.

(2) Questions regarding information in the Contract Documents that are not internal to the Contractor arise.

(3) Information not found in the Contract Documents is required.

B. All issues requiring clarification must be submitted as an RFI immediately. When possible, request such clarification either verbally or in writing at the next scheduled Project meeting. When the RFI is answered at the Project meeting, number the RFI and enter the response into the meeting minutes.

(1) When the urgency of the need or the complexity of the item makes clarification at the next scheduled Project meeting impractical, prepare and submit a formal written RFI to the District. Whenever possible, attempt to resolve potential RFI questions with Architect and/or PMO verbally, then submit confirming RFIs to document any resolved changes.

C. RFIs shall be submitted within a reasonable time frame so as not to interfere with or impede the progress of the Work. The Contractor shall make every effort to keep the number of RFIs to a minimum. If the number of RFIs becomes unwieldy, the District may require the Contractor to abandon the RFI process and submit requests as either submittals, substitutions, or requests for change.

D. When the response to an RFI effects the cost or time duration of the project, notify the District in accordance with the General Conditions at the time of the submittal. Notification shall occur prior to commencing such work, so that the change order process can be initiated.

(1) At time of submittal of the RFI, notify the District to the time available before the response will cause a time or cost impact to the Project.

(2) An answered RFI shall not be construed as approval to perform additional work.

E. Form of Submittal:

(1) Submit a legible written request as approved in advance by the District. Each request shall include the following information:

a. Project name, as listed on the Contract Documents, and District Project/Bid Number
b. Date
c. RFI number
d. Name, address, telephone and fax number of the Contractor
e. Number and title of affected Specification Section(s)
f. Drawing numbers and detail numbers as appropriate
g. Clear, concise explanation of information or clarification requested
h. Blank, lined spaces for District's response.
i. Signature block for District.

(2) Mark each page of each RFI attachment in the lower right corner with the RFI number.

(3) Number submitted RFIs consecutively

(4) Sign and stamp all RFI forms. RFIs from subcontractor or material suppliers shall be submitted through the Contractor. Contractor shall review all such information request prior to submitting to the District.

F. RFIs not meeting the requirements of this Section will not be answered and any consequential impact on the project shall be the sole

responsibility of the Contractor. Unanswered RFIs will be returned with a stamp or notification "Not Reviewed."

G. RFI Log: Contractor shall maintain and update the log weekly and furnish to the District when requested. The log shall contain the following minimum information:

(1) RFI number

(2) Date submitted

(3) Brief description of content or subject

(4) Date answered

H. Allow a minimum of five (5) working days for review and response. The response time will be increased if more information is required, when the RFI is submitted out of sequence, or if in the opinion of the District, more time is required to answer the RFI.

1.03 QUALITY ASSURANCE

A. Carefully review the Contract Documents before submitting a RFI to the District. Verify that the information requested is not indicated in the Contract Documents or cannot be determined from a careful review.

(1) The District may not answer RFIs for information that is readily available in the Contract Documents.

B. RFIs requesting clarification of coordination issues, shall include the Contractor's suggested solution as an attachment to the RFI.

(1) Such coordination issues include, but are not limited to, pipe and duct routing, clearances, specific locations of work shown diagrammatically, and similar items.

(2) Provide scale drawings or sketches indicating the proposed solution.

(3) RFIs which do not include a suggested solution will not be answered.

C. Do not use RFIs for the following:

(1) To request approval of submittals.

(2) To request approval of substitutions.

(3) To request changes to the Contract Documents and to confirm action taken by the Contractor for requested changes/substitutions to the Contract Documents.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF
SECTION

DOCUMENT 01 32 13

SCHEDULING OF WORK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

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

A. General Conditions;

B. Special Conditions;

C. Summary of Work; and

D. Submittals.

1.02 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.

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

1.03 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.

B. 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.

1.04 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.

B. 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.

1.05 GENERAL

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

B. 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.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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.

1.06 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.

B. 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.

C. Initial CPM Schedule shall be time scaled.

D. 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.

E. 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.

F. If, during the first ninety (90) days after Notice to Proceed, the Contractor is of the opinion that 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.

1.07 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.

B. 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) Each activity in the schedule shall include the following information: Activity Designation/Number – (Description Label or Name), Duration, Calendar ID, Early start date, Late start date, Early finish date, Late finish time, Identification of activities which comprise the critical path for completion, and Total float; 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. Coordinate with accepted schedule for submission of Shop Drawings, samples, and other submittals.

(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, and upon District request, 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 and key milestones.

(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.

C. Original CPM Schedule Review Meeting: Contractor shall, within sixty (45) 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:

(a) Clarifications of Contract Requirements.

(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.

1.08 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.

B. 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.

C. 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.

D. 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.

1.09 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.

B. 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.

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

D. 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.

E. 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.

B. 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.

C. 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.

D. 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.

E. 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.

B. The Recovery Schedule shall include all revised work schedules and manpower projections required to recover the delay. If it is required to work weekends the Contractor shall inform the District and request support from the District/PMO. The Contractor will be required to pay for all costs associated with the recovery work.

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

D. 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.

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

F. Under no circumstances will the addition of equipment or construction forces, increasing the working hours or any other method, manner, or procedure to return to the contractually required completion date be considered justification for a Contract Amendment or be treated as acceleration where the need for a recovery schedule has been caused by the Contractor and/or its Subcontractors, including its Suppliers/Vendors, at any tier.

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.

B. 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.

C. 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 one hard copy in addition to the electronic submittal of each TIE.

D. 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.

B. 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.

C. 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.

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

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

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

G. 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 one hard copy in addition to the electronic submittal of the following reports with the Initial CPM Schedule, the Original CPM Schedule, and each monthly update.

B. 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.

C. 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.

D. 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.

B. 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

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

On a daily basis, 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:

A. Project name and Project number.

B. Contractor's name and address.

C. Weather, temperature, and any unusual site conditions.

D. 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.

E. Worker quantities for its own Work force and for Subcontractors of any tier.

F. Equipment, other than hand tools, utilized by Contractor and Subcontractors.

1.18 PERIODIC VERIFIED REPORTS

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

DOCUMENT 01 33 00

SUBMITTALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Contractor's Submittals and Schedules, Drawings and Specifications;

B. Special Conditions.

1.02 SECTION INCLUDES:

A. Definitions:

(1) Shop Drawings and Product Data are as indicated in the General Conditions and include, but are not limited to, fabrication, erection, layout and setting drawings, formwork and falsework drawings, manufacturers' standard drawings, descriptive literature, catalogues, brochures, performance and test data, wiring and control diagrams. In addition, there are other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment or systems and all positions conform to the requirement of the Contract Documents, including, without limitation, the Drawings.

(2) "Manufactured" applies to standard units usually mass-produced; "fabricated" means specifically assembled or made out of selected materials to meet design requirements. Shop Drawings shall establish the actual detail of manufactured or fabricated items, indicated proper relation to adjoining work and amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure.

(3) Manufacturer's Instructions: Where any item of Work is required by the Contract Documents to be furnished, installed, or performed, at a minimum, in accordance with a specified product manufacturer's instructions, the Contractor shall procure and distribute copies of these to the District, the Architect, and all other concerned parties

and shall furnish, install, or perform the work, at a minimum, in accordance with those instructions.

B. Samples, Shop Drawings, Product Data, and other items as specified, in accordance with the following requirements:

(1) Contractor shall submit all Shop Drawings, Product Data, and Samples to the District, the Architect, the Project Inspector, and the Construction Manager.

(2) Contractor shall comply with all time frames herein and in the General Conditions and, in any case, shall submit required information in sufficient time to permit proper consideration and action before ordering any materials or items represented by such Shop Drawings, Product Data, and/or Samples.

(3) Contractor shall comply with all time frames herein and in the General Conditions and, in any case, shall allow sufficient time so that no delay occurs due to required lead time in ordering or delivery of any item to the Site. Contractor shall be responsible for any delay in progress of Work due to its failure to observe these requirements.

(4) Time for completion of Work shall not be extended on account of Contractor's failure to promptly submit Shop Drawings, Product Data, and/or Samples.

(5) Reference numbers on Shop Drawings shall have Architectural and/or Engineering Contract Drawings reference numbers for details, sections, and “cuts” shown on Shop Drawings. These reference numbers shall be in addition to any numbering system that Contractor chooses to use or has adopted as standard.

(6) When the magnitude or complexity of submittal material prevents a complete review within the stated time frame, Contractor shall make this submittal in increments to avoid extended delays.

(7) Contractor shall certify on submittals for review that submittals conform to Contract requirements. In event of any variance, Contractor shall specifically state in transmittal and on Shop Drawings, portions vary and require approval of a substitute. Also certify that Contractor-furnished equipment can be installed in allocated space.

(8) Unless specified otherwise, sampling, preparation of samples, and tests shall be in accordance with the latest standard of the American Society for Testing and Materials.

(9) Upon demand by Architect or District, Contractor shall submit samples of materials and/or articles for tests or examinations and consideration before Contractor incorporates same in Work. Contractor shall be solely responsible for delays due to sample(s) not being submitted in time to allow for tests. Acceptance or rejection will be expressed in writing. Work shall be equal to approved samples in every respect. Samples that are of value after testing will remain the property of Contractor.

C. Submittal Schedule:

(1) Contractor shall prepare its proposed submittal schedule that is coordinated with the its proposed construction schedule and submit both to the District within ten (10) days after the date of the Notice to Proceed. Contractor's proposed schedules shall become the Project Construction Schedule and the Project Submittal Schedule after each is approved by the District.

(2) Contractor is responsible for all lost time should the initial submittal be rejected, marked "revise and resubmit", etc.

(3) All Submittals shall be forwarded to the District by the date indicated on the approved Submittal Schedule, unless an earlier date is necessary to maintain the Construction Schedule, in which case those Submittals shall be forwarded to the District so as not to delay the Construction Schedule.

1.03 SHOP DRAWINGS:

A. Contractor shall submit one reproducible transparency and six (6) opaque reproductions. The District will review and return the reproducible copy and one (1) opaque reproduction to Contractor.

B. Before commencing installation of any Work, the Contractor shall submit and receive approval of all drawings, descriptive data, and material list(s) as required to accomplish Work.

C. Review of Shop Drawings is regarded as a service to assist Contractor and in all cases original Contract Documents shall take precedence as outlined under General Conditions.

D. No claim for extra time or payment shall be based on work shown on Shop Drawings unless the claim is (1) noted on Contractor's transmittal letter accompanying Shop Drawings and (2) Contractor has complied with all applicable provisions of the General Conditions, including, without limitation, provisions regarding changes and payment, and all required written approvals.

E. District shall not review Shop Drawings for quantities of materials or number of items supplied.

F. District's and/or Architect's review of Shop Drawing will be general. District and/or Architect review does not relieve Contractor of responsibility for dimensions, accuracy, proper fitting, construction of Work, furnishing of materials, or Work required by Contract Documents and not indicated on Shop Drawings. The District's and/or Architect's review of Shop Drawings is not to be construed as approving departures from Contract Documents.

G. Review of Shop Drawings and Schedules does not relieve Contractor from responsibility for any aspect of those Drawings or Schedules that is a violation of local, County, State, or Federal laws, rules, ordinances, or rules and regulations of commissions, boards, or other authorities or utilities having jurisdiction.

H. Before submitting Shop Drawings for review, Contractor shall check Shop Drawings of its subcontractors for accuracy, and confirm that all Work contiguous with and having bearing on other work shown on Shop Drawings is accurately drawn and in conformance with Contract Documents.

I. Submitted drawings and details must bear stamp of approval of Contractor:

(1) Stamp and signature shall clearly certify that Contractor has checked Shop Drawings for compliance with Drawings.

(2) If Contractor submits a Shop Drawing without an executed stamp of approval, or whenever it is evident (despite stamp) that Drawings have not been checked, the District and/or Architect will not consider them and will return them to the Contractor for revision and resubmission. In that event, it will be deemed that Contractor has not complied with this provision and Contractor shall bear risk of all delays to same extent as if it had not submitted any Shop Drawings or details.

J. Submission of Shop Drawings (in either original submission or when resubmitted with correction) constitutes evidence that Contractor has checked all information thereon and that it accepts and is willing to perform Work as shown.

K. Contractor shall pay for cost of any changes in construction due to improper checking and coordination. Contractor shall be responsible for all additional costs, including coordination. Contractor shall be responsible for costs incurred by itself, the District, the Architect, the

Project Inspector, the Construction Manager, any other Subcontractor or contractor, etc., due to improperly checked and/or coordination of submittals.

L. Shop Drawings must clearly delineate the following information:

(1) Project name and address.

(2) Specification number and description.

(3) Architect's name and project number.

(4) Shop Drawing title, number, date, and scale.

(5) Names of Contractor, Subcontractor(s) and fabricator.

(6) Working and erection dimensions.

(7) Arrangements and sectional views.

(8) Necessary details, including complete information for making connections with other Work.

(9) Kinds of materials and finishes.

(10) Descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Contractor shall use same reference identification(s) as shown on Contract Drawings.

M. Contractor shall prepare composite drawings and installation layouts when required to solve tight field conditions.

(1) Shop Drawings shall consist of dimensioned plans and elevations and must give complete information, particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc.

(2) Contractor shall coordinate these composite Shop Drawings and installation layouts in the field between itself and its Subcontractor(s) for proper relationship to the Work, the work of other trades, and the field conditions. The Contractor shall check and approve all submittal(s) before submitting them for final review.

1.04 PRODUCT DATA OR NON REPRODUCIBLE SUBMITTALS:

A. Contractor shall submit manufacturer's printed literature in original form. Any fading type of reproduction will not be accepted. Contract must submit a minimum of six (6) each, to the District. District shall return one (1) to the Contractor, who shall reproduce whatever additional copies it requires for distribution.

B. Contractor shall submit six (6) copies of a complete list of all major items of mechanical, plumbing, and electrical equipment and materials in accordance with the approved Submittal Schedule, except as required earlier to comply with the approved Construction Schedule. Other items specified are to be submitted prior to commencing Work. Contractor shall submit items of like kind at one time in a neat and orderly manner. Partial lists will not be acceptable.

C. Submittals shall include manufacturer's specifications, physical dimensions, and ratings of all equipment. Contractor shall furnish performance curves for all pumps and fans. Where printed literature describes items in addition to that item being submitted, submitted item shall be clearly marked on sheet and superfluous information shall be crossed out. If highlighting is used, Contractor shall mark all copies.

D. Equipment submittals shall be complete and include space requirements, weight, electrical and mechanical requirements, performance data, and supplemental information that may be requested.

E. Imported Materials Certification must be submitted at least ten (10) days before material is delivered.

1.05 SAMPLES:

A. Contractor shall submit for approval Samples as required and within the time frame in the Contract Documents. Materials such as concrete, mortar, etc., which require on-site testing will be obtained from Project Site.

B. Contractor shall submit four (4) samples except where greater or lesser number is specifically required by Contract Documents including, without limitation, the Specifications.

(1) Samples must be of sufficient size and quality to clearly illustrate functional characteristics, with integrally related parts and attachment devices.

(2) Samples must show full range of texture, color, and pattern.

C. Contractor shall make all Submittals, unless it has authorized Subcontractor(s) to submit and Contractor has notified the District in writing to this effect.

D. Samples to be shipped prepaid or hand-delivered to the District.

E. Contractor shall mark samples to show name of Project, name of Contractor submitting, Contract number and segment of Work where representative Sample will be used, all applicable Specifications Sections and documents, Contract Drawing Number and detail, and ASTM or FS reference, if applicable.

F. Contractor shall not deliver any material to Site prior to receipt of District's and/or Architect’s completed written review and approval. Contractor shall furnish materials equal in every respect to approved Samples and execute Work in conformance therewith.

G. District's and/or Architect’s review, acceptance, and/or approval of Sample(s) will not preclude rejections of any material upon discovery of defects in same prior to final acceptance of completed Work.

H. After a material has been approved, no change in brand or make will be permitted.

I. Contractor shall prepare its Submittal Schedule and submit Samples of materials requiring laboratory tests to specified laboratory for testing not less than ninety (90) days before such materials are required to be used in Work.

J. Samples which are rejected must be resubmitted promptly after notification of rejection and be marked "Resubmitted Sample" in addition to other information required.

K. Field Samples and Mock-Ups are to be removed by Contractor at District’s direction:

(1) Size: As Specified.

(2) Furnish catalog numbers and similar data, as requested.

1.06 REVIEW AND RESUBMISSION REQUIREMENTS:

A. The District will arrange for review of Sample(s), Shop Drawing(s), Product Data, and other submittal(s) by appropriate reviewer and return to Contractor as provided below within twenty-one (21) days after receipt or within twenty-one (21) days after receipt of all related information necessary for such review, whichever is later.

B. One (1) copy of product or materials data will be returned to Contractor with the review status.

C. Samples to be incorporated into the Work will be returned to Contractor, together with a written notice designating the Sample with the appropriate review status and indicating errors discovered on review, if any. Other Samples will not be returned, but the same notice will be given with respect thereto, and that notice shall be considered a return of the Sample.

D. Contractor shall revise and resubmit any Sample(s), Shop Drawing(s), Product Data, and other submittal(s) as required by the reviewer. Such resubmittals will be reviewed and returned in the same manner as original Sample(s), Shop Drawing(s), Product Data, and other submittal(s), within fourteen (14) days after receipt thereof or within fourteen (14) days after receipt of all related information necessary for such review. Such resubmittal shall not delay the Work.

E. Contractor may proceed with any of the Work covered by Sample(s), Shop Drawing(s), Product Data, and other submittal(s) upon its return if designated as no exception taken, or revise as noted, provided the Contractor proceeds in accordance with the District and/or the Architect's notes and comments.

F. Contractor shall not begin any of the work covered by a Sample(s), Shop Drawing(s), Product Data, and other submittal(s), designated as revise and resubmit or rejected, until a revision or correction thereof has been reviewed and returned to Contractor.

G. Sample(s), Shop Drawing(s), Product Data, and other submittal(s) designated as revise and resubmit or rejected and requiring resubmittal, shall be revised or corrected and resubmitted to the District no later than fourteen (14) days or a shorter period as required to comply with the approved Construction Schedule, after its return to Contractor.

H. Neither the review nor the lack of review of any Sample(s), Shop Drawing(s), Product Data, and other submittal(s) shall waive any of the requirements of the Contract Documents, or relieve Contractor of any obligation thereunder.

I. District's and/or Architect's review of Shop Drawings does not relieve the Contractor of responsibility for any errors that may exist. Contractor is responsible for the dimensions and design of adequate connections and details and for satisfactory construction of all the Work.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 41 00

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Obtaining of Permits, Licenses and Registrations and Work to Comply with All Applicable Laws and Regulations;

B. Special Conditions; and

C. Quality Control.

1.02 DESCRIPTION:

This section covers the general requirements for regulatory requirements pertaining to the Work and is supplementary to all other regulatory requirements mentioned or referenced elsewhere in the Contract Documents.

1.03 REQUIREMENTS OF REGULATORY AGENCIES:

A. All statutes, ordinances, laws, rules, codes, regulations, standards, and the lawful orders of all public authorities having jurisdiction over the Work, are hereby incorporated into these Contract Documents as if repeated in full herein and are intended to be included in any reference to Code or Building Code, unless otherwise specified, including, without limitation, the references in the list below. Contractor shall make available at the Site copies of all the listed documents applicable to the Work as the District and/or Architect may request, including, without limitation, applicable portions of the California Code of Regulations ("CCR").

(1) California Building Standards Administrative Code, Part 1, Title 24, CCR.

(2) California Building Code (CBC), Part 2, Title 24, CCR; (International Building Code volumes 1-2 and California Amendments).

(3) California Electrical Code (CEC), Part 3, Title 24, CCR; (National Electrical Code and California Amendments).

(4) California Mechanical Code (CMC), Part 4, Title 24, CCR; (Uniform Mechanical Code and California Amendments).

(5) California Plumbing Code (CPC), Part 5, Title 24, CCR; (Uniform Plumbing Code and California Amendments).

(6) California Fire Code (CFC), Part 9, Title 24, CCR; (International Fire Code and California Amendments).

(7) California Referenced Standards Code, Part 12, Title 24, CCR.

(8) State Fire Marshal Regulations, Public Safety, Title 19, CCR.

(9) Partial List of Applicable National Fire Protection Association (NFPA) Standards:

(a) NFPA 13 - Automatic Sprinkler System.

(b) NFPA 14 - Standpipes Systems.

(c) NFPA 17A - Wet Chemical System

(d) NFPA 24 - Private Fire Mains.

(e) (California Amended) NFPA 72 - National Fire Alarm Codes.

(f) NFPA 253 - Critical Radiant Flux of Floor Covering System.

(g) NFPA 2001 - Clean Agent Fire Extinguishing Systems.

(10) California Division of the State Architect interpretation of Regulations (“DSA IR”), including, without limitation:

(a) DSA IR A-6 — Construction Change Document Submittal and Approval Processes.

(b) DSA IR A-7 — Project Inspector Certification and Approval.

(c) DSA IR A-8 — Project Inspector and Assistant Inspector Duties and Performance.

(d) DSA IR A-12 — Assistant Inspector Approval.

(11) DSA Procedures (“DSA PR”)

(a) DSA PR 13-01 – Construction Oversight Process

(12) DSA PR 13-02 – Project Certification Process

B. This Project shall be governed by applicable regulations, including, without limitation, the State of California's Administrative Regulations for the Division of the State Architect-Structural Safety (DSA/SS), Chapter 4, Part 1, Title 24, CCR, and the most current version on the date the bids are opened and as it pertains to school construction including, without limitation:

(1) Test and testing laboratory per Section 4-335. District shall pay for the testing laboratory.

(2) Special inspections per Section 4-333(c).

(3) Deferred Approvals per section 4-317(g).

(4) Verified reports per Sections 4-336 & 4-343(c).

(5) Duties of the Architect & Engineers shall be per Section 4-333(a) and 4-341.

(6) Duties of the Contractor shall be per Section 4-343.

(7) Duties of Project Inspector shall be per Section 4-334.

(8) Addenda and Construction Change Documents per Section 4-338.

Contractor shall keep and make available all applicable parts of the most current version of Title 24 referred to in the plans and specifications at the Site during construction.

C. Items of deferred approval shall be clearly marked on the first sheet of the Architect's and/or Engineer's approved Drawings. All items later submitted for approval shall be per Title 24 requirements to the DSA.

(1) Contractor shall submit the following to Architect for review and endorsement:

(a) Product information on proposed material/system supplier.

(b) Drawings, specifications, and calculations prepared, signed, and stamped by an architect or engineer licensed in the State of California for that portion of the Work.

(c) All other requirements as may be required by DSA.

(2) Cost of preparing and submitting documentation per DSA Deferred Approval requirements including required modifications to Drawings

and Specifications, whether or not indicated in the Contract Documents, shall be borne by Contractor.

(3) Contractor shall not begin fabrication and installation of deferred approval items without first obtaining DSA approval of Drawings and Specifications.

(4) Schedule of Work Subject to DSA Deferred Approval: Window wall systems exceeding 10 feet in span.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 43 00

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

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

A. General Conditions, including, without limitation, Purchase of Materials and Equipment;

B. Special Conditions;

C. Imported Materials Certification.

1.02 MATERIAL AND EQUIPMENT

A. Only items approved by the District and/or Architect shall be used.

B. Contractor shall submit lists of products and other product information in accordance with the Contract Documents, including, without limitation, the provisions regarding the submittals.

1.03 MATERIAL AND EQUIPMENT COLORS

A. The District and/or Architect will provide a schedule of colors.

B. No individual color selections will be made until after approval of all pertinent materials and equipment and after receipt of appropriate samples in accordance with the Contract Documents, including, without limitation, the provisions regarding the submittals.

C. Contractor shall request priority in writing for any item requiring advance ordering to maintain the approved Construction Schedule.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall deliver manufactured materials in original packages, containers, or bundles (with seals unbroken), bearing name or identification mark of manufacturer.

B. Contractor shall deliver fabrications in as large assemblies as practicable; where specified as shop-primed or shop-finished, package or crate as required to preserve such priming or finish intact and free from abrasion.

C. Contractor shall store materials in such a manner as necessary to properly protect them from damage. Materials or equipment damaged by handling, weather, dirt, or from any other cause will not be accepted.

D. Materials are not acceptable that have been warehoused for long periods of time, stored or transported in improper environment, improperly packaged, inadequately labeled, poorly protected, excessively shipped, deviated from normal distribution pattern, or reassembled.

E. Contractor shall store material so as to cause no obstructions of sidewalks, roadways, access to the Site or buildings, and underground services. Contractor shall protect material and equipment furnished under Contract.

F. Contractor may store materials on Site with prior written approval by the District, all material shall remain under Contractor's control and Contractor shall remain liable for any damage to the materials. Should the Project Site not have storage area available, the Contractor shall provide for off-site storage at a bonded warehouse and with appropriate insurance coverage at no cost to District.

G. When any room in Project is used as a shop or storeroom, the Contractor shall be responsible for any repairs, patching, or cleaning necessary due to that use. Location of storage space shall be subject to prior written approval by District.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers listed in various sections of Contract Documents are names of those manufacturers that are believed to be capable of supplying one or more of items specified therein.

B. The listing of a manufacturer does not imply that every product of that manufacturer is acceptable as meeting the requirements of the Contract Documents.

2.02 FACILITIES AND EQUIPMENT

Contractor shall provide, install, maintain, and operate a complete and adequate facility for handling, the execution, disposal, and distribution of material and equipment as required for proper and timely performance of Work connected with Contract.

2.03 MATERIAL REFERENCE STANDARDS

Where material is specified solely by reference to “standard specifications” and if requested by District, Contractor shall submit for review data on actual material proposed to be incorporated into Work of Contract listing name and address of vendor, manufacturer, or producer, and trade or brand names of those materials, and data substantiating compliance with standard specifications.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. Where not more specifically described in any other Contract Documents, workmanship shall conform to methods and operations of best standards and accepted practices of trade or trades involved and shall include items of fabrication, construction, or installation regularly furnished or required for completion (including finish and for successful operation, as intended).

B. Work shall be executed by tradespersons skilled in their respective lines of Work. When completed, parts shall have been durably and substantially built and present a neat appearance.

3.02 COORDINATION

A. Contractor shall coordinate installation of Work so as to not interfere with installation of others. Adjustment or rework because of Contractor’s failure to coordinate will be at no additional cost to District.

B. Contractor shall examine in-place work for readiness, completeness, fitness to be concealed or to receive other work, and in compliance with Contract Documents. Concealing or covering Work constitutes acceptance of additional cost which will result should in-place Work be found unsuitable for receiving other Work or otherwise deviating from the requirements of the Contract Documents.

3.03 COMPLETENESS

Contractor shall provide all portions of the Work, unless clearly stated otherwise, installed complete and operational with all elements, accessories, anchorages, utility connections, etc., in manner to assure well-balanced performance, in accordance with manufacturer's recommendations and by Contract Documents. For example, electric water coolers require water, electricity, and drain services; roof drains require drain system; sinks fit within countertop, etc. Terms such as “installed complete,” “operable condition,” “for use intended,” “connected to all utilities,” “terminate with proper cap,” “adequately anchored,” “patch and refinish,” “to match similar,” should be assumed to apply in all cases, except where completeness of functional or operable condition is specifically stated as not required.

3.04 APPROVED INSTALLER OR APPLICATOR

Installation by a manufacturer's approved installer or applicator is an understood part of Specifications and only approved installer or applicator is to provide on-site Work where specified manufacturer has on-going program of approving (i.e. certifying, bonding, re-warranting) installers or applicators. Newly established relationships between a manufacturer and an installer or applicator who does not have other approved applicator work in progress or completed is not approved for this Project.

3.05 MANUFACTURER'S RECOMMENDATIONS

All installations shall be in accordance with manufacturer's published recommendations and specific written directions of manufacturer's representative. Should Contract Documents differ from recommendations of manufacturer or directions of his representative, Contractor shall analyze differences, make recommendations to the District and the Architect in writing, and shall not proceed until interpretation or clarification has been issued by the District and/or the Architect.

END OF DOCUMENT

DOCUMENT 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Inspector, Inspections and Tests, Uncovering of Work and Non-conforming of Work and Correction of Work;

B. Special Conditions.

1.02 RELATED CODES:

A. The Work is governed by requirements of Title 24, California Code of Regulations ("CCR"), and the Contractor shall keep a copy of these available at the job Site for ready reference during construction.

B. The Division of the State Architect ("DSA") shall be notified at or before the start of construction.

1.03 OBSERVATION AND SUPERVISION:

A. The District and Architect or their appointed representatives will review the Work and the Contractor shall provide facilities and access to the Work at all times as required to facilitate this review. Administration by the Architect and any consulting Structural Engineer will be in accordance with applicable regulations, including, without limitation, CCR, Part 1, Title 24, Section 4-341.

B. One or more Project Inspector(s) approved by DSA and employed by or in contract with the District, referred to hereinafter as the "Project Inspector", will observe the work in accordance with CCR, Part 1, Title 24, Sections 4-333(b) and 4-342:

(1) The Project Inspector and Special Inspector(s) shall have access to the Work wherever it is in preparation or progress for ascertaining that the Work is in accordance with the Contract Documents and all applicable code sections. The Contractor shall provide facilities and operation of equipment as needed, and access as required and shall provide assistance for sampling or measuring materials.

(2) The Project Inspector will notify the District and Architect and call the attention of the Contractor to any observed failure of Work or material to conform to Contract Documents.

(3) The Project Inspector shall observe and monitor all testing and inspection activities required.

The Contractor shall conform with all applicable laws as indicated in the Contract Documents, including, without limitation, to CCR, Part 1, Title 24, Section 4-343. The Contractor shall supervise and direct the Work and maintain a competent superintendent on the job who is authorized to act in all matters pertaining to the Work. The Contractor's superintendent shall also inspect all materials, as they arrive, for compliance with the Contract Documents. Contractor shall reject defective Work or materials immediately upon delivery or failure of the Work or material to comply with the Contract Documents. The Contractor shall submit verified reports as indicated in the Contract Documents, including, without limitation, the Specifications and as required by Part 1, Title 24, Section 4-336.

1.04 TESTING AGENCIES:

A. Testing agencies and tests shall be in conformance with the General Documents and the requirements of Part 1, Title 24, Section 4- 335.

B. Testing and inspection in connection with earthwork shall be under the direction of the District's consulting soils engineer, if any, referred to hereinafter as the "Soils Engineer."

C. Testing and inspection of construction materials and workmanship shall be performed by a qualified laboratory, referred to hereinafter as the "Testing Laboratory." The Testing Laboratory shall be under direction of an engineer registered in the State of California, shall conform to requirements of ASTM E329, and shall be employed by or in contract with the District.

1.05 TESTS AND INSPECTIONS:

A. The Contractor shall be responsible for notifying the District and Project Inspector of all required tests and inspections. Contractor shall notify the District and Project Inspector at least seventy-two hours (72) hours in advance of performing any Work requiring testing or inspection.

B. The Contractor shall provide access to Work to be tested and furnish incidental labor, equipment, and facilities to facilitate all inspections and tests.

C. The District will pay for first inspections and tests required by the "CCR", and other inspections or tests that the District and/or the Architect may direct to have made, including the following principal items:

(1) Tests and observations for earthwork and paving.

(2) Tests for concrete mix designs, including tests of trial batches.

(3) Tests and inspections for structural steel work.

(4) Field tests for framing lumber moisture content.

(5) Additional tests directed by the District that establish that materials and installation comply with the Contract Documents.

(6) Tests and observations of welding and expansion anchors.

D. The District may at its discretion, pay and then back charge the Contractor for:

(1) Retests or reinspections, if required, and tests or inspections required due to Contractor error or lack of required identifications of material.

(2) Uncovering of work in accordance with Contract Documents.

(3) Testing done on weekends, holidays, and overtime will be chargeable to the Contractor for the overtime portion.

(4) Testing done off Site.

E. Testing and inspection reports and certifications:

(1) If initially received by Contractor, Contractor shall provide to each of the following a copy of the agency or laboratory report of each test or inspection or certification.

(a) The District;

(b) The Construction Manager, if any;

(c) The Architect;

(d) The Consulting Engineer, if any;

(e) Other engineers on the Project, as appropriate;

(f) The Project Inspector; and

(g) The Contractor.

(2) When the test or inspection is one required by the CCR, a copy of the report shall also be provided to the DSA.

PART 2 - PRODUCTS

2.01 TYPE OF TESTS AND INSPECTIONS:

A. Testing and inspection shall be in accordance with DSA Form 103 (or current version). Tests below are typical examples and not fully inclusive of all tests and special inspections that may be required.

B. Slump Test
ASTM C 143

C. Concrete Tests

Testing agency shall test concrete used in the work per the following paragraphs:

(1) Compressive Strength:

(a) Minimum number of tests required: One (1) set of three (3) cylinders for each 100 cubic yards (Sec. 2604(h) 01) of concrete or major fraction thereof, placed in one (1) day. See Title 24, Section 2605(g).

(b) Two cylinders of each set shall be tested at twenty-eight (28) days. One (1) cylinder shall be held in reserve and tested only when directed by the Architect or District.

(c) Concrete shall test the minimum ultimate compressive strength in twenty-eight (28) days, as specified on the structural drawings.

(d) In the event that the twenty-eight (28) day test falls below the minimum specified strength, the effective concrete in place shall be tested by taking cores in accordance with UBC Standard No. 26-13 and tested as required for cylinders.

(e) In the event that the test on core specimens falls below the minimum specified strength, the concrete will be deemed defective and shall be removed and replaced upon such direction of the Architect, and in a manner acceptable to the Division of the State Architect.

D. Reinforcing, Steel

E. Structural Steel Per Title 24 and as noted:

(1) Material: Steel per Table in Title 24, Section 2712.

(2) Qualification of Welders (UBC Std. 27-6).

(3) Shop fabrication (Section 2712(d). Structural steel only).

(4) Shop and field welding (Section 2712(e)).

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions;

B. Special Conditions;

C. Site Standards; and

D. Construction Waste Management and Disposal.

1.02 TEMPORARY UTILITIES:

A. Electric Power and Lighting:

(1) To the extent power is available in the building(s) or on the Site, Contractor may use the District's existing utilities for the utilities used by Contractor and all Subcontractors. Contractor shall be responsible for providing temporary facilities required to deliver that power service from its existing location in the building(s) or on the Site to point of intended use.

(2) Contractor shall verify characteristics of power available in building(s) or on the Site. Contractor shall take all actions required to make modifications where power of higher voltage or different phases of current are required. Contractor shall be fully responsible for providing that service and shall pay all costs required therefor.

(3) Contractor shall furnish, wire for, install, and maintain temporary electrical lights wherever it is necessary to provide illumination for the proper performance and/or observation of the Work: a minimum of 20 foot-candles for rough work and 50 foot-candles for finish work.

(4) Contractor shall be responsible for maintaining existing lighting levels in the project vicinity should temporary outages or service interruptions occur.

B. Heat and Ventilation:

(1) Contractor shall provide temporary heat to maintain environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation and curing of materials, and to protect materials and finishes from damage due to improper temperature and humidity conditions. Portable heaters shall be standard units complete with controls.

(2) Contractor shall provide forced ventilation and dehumidification, as required, of enclosed areas for proper installation and curing of materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors, and gases.

(3) Contractor shall pay the costs of installation, maintenance, operation, and removal of temporary heat and ventilation, including costs for fuel consumed, required for the performance of the Work.

C. Water:

(1) Contractor shall coordinate and pay for installation or use of water meter in compliance with local water agency requirements. To the extent water is then available in the building(s) or on the Site, Contractor may use the District's existing utilities by making prearranged payments to the District for the utilities used by Contractor and all Subcontractors. Contractor shall be responsible for providing temporary facilities required to deliver such utility service from its existing location in the building(s) on the Site, or other location approved by the local water agency, to point of intended use.

(2) Contractor shall use backflow preventers on water lines at point of connection to District's water supply. Backflow preventers shall comply with requirements of Uniform Plumbing Code.

(3) Contractor shall make potable water available for human consumption.

D. Sanitary Facilities:

(1) Contractor shall provide sanitary temporary facilities in no fewer numbers than required by law and such additional facilities as may be directed by the Inspector for the use of all workers. The facilities shall be maintained in a sanitary condition at all times and shall be left at the Site until removal is directed by the Inspector or Contractor completes all other work at the Site.

(2) Use of toilet facilities in the Work under construction shall not be permitted except by consent of the Inspector and the District.

E. Telephone Service:

(1) Contractor shall arrange with local telephone service company for telephone service as required for the performance of the Work. Contractor shall, at a minimum, provide in its field office one line for telephone and one line for fax machine.

(2) Contractor shall pay the costs for telephone and fax lines installation, maintenance, service, and removal.

F. Fire Protection:

(1) Contractor shall provide and maintain fire extinguishers and other equipment for fire protection. Such equipment shall be designated for use for fire protection only and shall comply with all requirements of the California Fire, State Fire Marshall and/or its designee.

(2) Where on-site welding and burning of steel is unavoidable, Contractor shall provide protection for adjacent surfaces.

G. Trash Removal:

(1) Contractor shall provide trash removal on a timely basis. Under no circumstance shall Contractor use District trash service.

H. Field Office:

(1) If Contractor chooses to provide a field office, it shall be an acceptable construction trailer that is well-lit and ventilated. The construction trailer shall be equipped with shelves, desks, filing cabinet, chairs, and such other items of equipment needed. Trailer and equipment are the property of the Contractor and must be removed from the Site upon completion of the Work. Contractor may use the corridor adjacent to the construction area for an office area, if approved in writing by District.

(2) Contractor shall provide any additional electric lighting and power required for the trailer. Contractor shall make adequate provisions for heating and cooling as required.

1.03 CONSTRUCTION AIDS:

A. Plant and Equipment:

(1) Contractor shall furnish, operate, and maintain a complete plant for fabricating, handling, conveying, installing, and erecting materials and equipment; and for conveyances for transporting workers. Include elevators, hoists, debris chutes, and other equipment, tools, and appliances necessary for performance of the Work.

(2) Contractor shall maintain plant and equipment in safe and efficient operating condition. Damages due to defective plant and equipment, and uses made thereof, shall be repaired by Contractor at no expense to the District.

B. None of the District's tools and equipment shall be used by Contractor for the performance of the Work.

1.04 BARRIERS AND ENCLOSURES:

A. Contractor shall obtain the District's written permission for locations and types of temporary barriers and enclosures, including fire-rated materials proposed for use, prior to their installation.

B. Contractor shall provide and maintain temporary enclosures to prevent public entry and to protect persons using other buildings and portions of the Site and/or Premises, the public, and workers. Contractor shall also protect the Work and existing facilities from the elements, and adjacent construction and improvements, persons, and trees and plants from damage and injury from demolition and construction operations.

C. Contractor shall provide site access to existing facilities for persons using other buildings and portions of the Site, the public, and for deliveries and other services and activities.

D. Tree and Plant Protection:

(1) Contractor shall preserve and protect existing trees and plants on the Premises that are not designated or required to be removed, and those adjacent to the Premises.

(2) Contractor shall provide barriers to a minimum height of 4'-0" around drip line of each tree and plant, around each group of trees and plants, as applicable, in the proximity of demolition and construction operations, or as denoted on the Plans.

(3) Contractor shall not park trucks, store materials, perform Work or cross over landscaped areas. Contractor shall not dispose of paint thinners, water from cleaning, plastering or concrete operations, or other deleterious materials in landscaped areas, storm drain systems, or sewers. Plant materials damaged as a result of the

performance of the Work shall, at the option of the District and at Contractor's expense, either be replaced with new plant materials equal in size to those damaged or by payment of an amount representing the value of the damaged materials as determined by the District.

(4) Contractor shall remove soil that has been contaminated during the performance of the Work by oil, solvents, and other materials which could be harmful to trees and plants, and replace with good soil, at Contractor's expense.

(5) Excavation around Trees:

(a) Excavation within drip lines of trees shall be done only where absolutely necessary and with written permission from the District.

(b) Where trenching for utilities is required within drip lines, tunneling under and around roots shall be by hand digging and shall be approved by the District. Main lateral roots and taproots shall not be cut. All roots 2 inches in diameter and larger shall be tunneled under and heavily wrapped with wet burlap so as to prevent scarring or excessive drying. Smaller roots that interfere with installation of new work may be cut with prior approval by the District. Roots must first be cut with a Vermeer, or equivalent, root cutter prior to any trenching.

(c) Where excavation for new construction is required within drip line of trees, hand excavation shall be employed to minimize damage to root system. Roots shall be relocated in backfill areas wherever possible. If encountered immediately adjacent to location of new construction, roots shall be cut approximately 6 inches back from new construction.

(d) Approved excavations shall be carefully backfilled with the excavated materials approved for backfilling. Backfill shall conform to adjacent grades without dips, sunken areas, humps, or other surface irregularities. Do not use mechanical equipment to compact backfill. Tamp carefully using hand tools, refilling and tamping until Final Acceptance as necessary to offset settlement.

(e) Exposed roots shall not be allowed to dry out before permanent backfill is placed. Temporary earth cover shall be provided, or roots shall be wrapped with four layers of

wet, untreated burlap and temporarily supported and protected from damage until permanently relocated and covered with backfill.

(f) Accidentally broken roots should be sawed cleanly 3 inches behind ragged end.

1.05 SECURITY:

The Contractor shall be responsible for project security for materials, tools, equipment, supplies, and completed and partially completed Work.

1.06 TEMPORARY CONTROLS:

A. Noise Control:

(1) Contractor acknowledges that adjacent facilities may remain in operation during all or a portion of the Work period, and it shall take all reasonable precautions to minimize noise as required by applicable laws and the Contract Documents.

(2) Notice of proposed noisy operations, including without limitation, operation of pneumatic demolition tools, concrete saws, and other equipment, shall be submitted to the District a minimum of forty-eight (48) hours in advance of their performance.

B. Noise and Vibration:

(1) Equipment and impact tools shall have intake and exhaust mufflers.

(2) Contractor shall cooperate with District to minimize and/or cease the use of noisy and vibratory equipment if that equipment becomes objectionable by its longevity.

C. Dust and Dirt:

(1) Contractor shall conduct demolition and construction operations to minimize the generation of dust and dirt, and prevent dust and dirt from interfering with the progress of the Work and from accumulating in the Work and adjacent areas including, without limitation, occupied facilities.

(2) Contractor shall periodically water exterior demolition and construction areas to minimize the generation of dust and dirt.

(3) Contractor shall ensure that all hauling equipment and trucks carrying loads of soil and debris shall have their loads sprayed with

water or covered with tarpaulins, and as otherwise required by local and state ordinance.

(4) Contractor shall prevent dust and dirt from accumulating on walks, roadways, parking areas, and planting, and from washing into sewer and storm drain lines.

D. Water:

Contractor shall not permit surface and subsurface water, and other liquids, to accumulate in or about the vicinity of the Premises. Should accumulation develop, Contractor shall control the water or other liquid, and suitably dispose of it by means of temporary pumps, piping, drainage lines, troughs, ditches, dams, or other methods.

E. Pollution:

(1) No burning of refuse, debris, or other materials shall be permitted on or in the vicinity of the Premises.

(2) Contractor shall comply with applicable regulatory requirements and anti-pollution ordinances during the conduct of the Work including, without limitation, demolition, construction, and disposal operations.

F. Lighting:

(1) If portable lights are used after dark, all light must be located so as not to direct light into neighboring property.

1.07 JOB SIGN(S):

A. General:

(1) Contractor shall provide and maintain a Project identification sign with the design, text, and colors designated by the District and/or the Design Professional; locate sign as approved by the District.

(2) Signs other than the specified Project sign and or signs required by law, for safety, or for egress, shall not be permitted, unless otherwise approved in advance by the District.

B. Materials:

(1) Structure and Framing: Structurally sound, new or used wood or metal; wood shall be nominal 3/4-inch exterior grade plywood.

(2) Sign Surface: Minimum 3/4-inch exterior grade plywood.

(3) Rough Hardware: Galvanized.

(4) Paint: Exterior quality, of type and colors selected by the District and/or the Design Professional.

C. Fabrication:

(1) Contractor shall fabricate to provide smooth, even surface for painting.

(2) Size: 4'-0" x 8'-0", unless otherwise indicated.

(3) Contractor shall paint exposed surfaces of supports, framing, and surface material with exterior grade paint: one coat of primer and one coat of finish paint.

(4) Text and Graphics: As indicated.

1.08 PUBLICITY RELEASES:

A. Contractor shall not release any information, story, photograph, plan, or drawing relating information about the Project to anyone, including press and other public communications medium, including, without limitation, on website(s) without the written permission of the District.

PART 2 – PRODUCTS Not used.

PART 3 – EXECUTION Not used.

END OF DOCUMENT

SECTION 015639
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. Construction Drawings, Technical Specifications, Addenda, and general provisions of the Contract, including Contract General Conditions and Supplementary General Conditions and other 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 22 00 Grading
4. 31 23 16 Excavation
5. 31 23 23 Fill: Compacted Subbase for Paving
6. 32 12 16 Asphalt Paving
7. 32 13 13 Concrete Paving
8. 32 13 16 Decorative Concrete Paving
9. 32 84 00 Landscape Irrigation
10. 32 93 13 Lawns and Grasses
11. 32 93 16 Exterior Plants
12. 33 41 11 Storm Utility Drainage Piping

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. In the event that the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. In the event that the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail.

1. ANSI A 300 (Part 5) – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current editions.

2. Pruning practices shall conform with recommendations “Structural Pruning: A Guide for The Green Industry”; Published by Urban Tree Foundation, Visalia, California; most current edition.

3. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign Il, most current edition.

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 College’s Representative 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 College’s Representative.

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 College’s Representative.

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 College’s Representative.

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 College's Representative 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 College's Representative.

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. Two signs shall be attached to each tree protection fence in prominently visible locations. The tree protections sign shall read, "Tree and Plant Protection Area- Keep Out" in both English and Spanish.

2.4 FERTILIZER

A. Fertilizer: Unless otherwise directed by College's Representative, type and quantity of fertilizer shall be determined by soil agronomist engaged and paid by Contractor, who is acceptable to College's Representative.

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.

B. Accessory Materials: As determined by Contractor as necessary for sustained health of trees and plants, subject to acceptance by College's Representative. Accessory materials shall include mulch, tree and plant stakes, and temporary covers.

PART 3 - EXECUTION

1.1 PROTECTION

A. Protection: Prior to construction activities, especially demolition and excavation, on the site, Contractor shall submit to College's Representative 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.

1.2 PRUNING

A. Engage approved Arborist, registered by the American Society of Consulting Arborists. Contact College's rep 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 College's Representative, 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 College's Representative.

1.3 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 College's Representative.

B. All trees shall be deep root watered by the use of 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 (6) months, in addition to the normal watering schedule.

1.4 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.

1.5 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.

1.6 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 College’s Representative.

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 College’s Representative shall be notified prior to this work. Measures as approved by the College’s Representative, such as small retaining walls or subgrade aeration lines, may be required to mitigate construction procedures affecting the tree.

1.7 REPAIR AND REMOVAL OF TREES

A. Repair and Removal of Trees: Certified Arborist and College's Representative will determine whether trees shall be restored or removed. Treat and restore trees damaged by construction operations in a manner acceptable to College's Representative. 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 College's 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.

1.8 REPAIR AND REPLACEMENT OF SHRUBS AND GROUND COVER

A. Repair shrubs and other vegetation damaged by construction operations in a manner acceptable to College's Representative. 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 College's Representative 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 College's Representative.

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 College's Representative.

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 College's Representative 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 College's Representative.

1.9 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 College's Representative. Because of the irreplaceable nature of many of the existing trees, the amount of assessment shall be determined by the College's Representative, depending upon tree species, condition before damage, and location value.

END OF SECTION

SECTION 01 66 00

PRODUCT DELIVERY, STORAGE AND HANDLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

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

A. General Conditions, including, without limitation, Site Access, Conditions and Requirements;

B. Special Conditions.

1.02 PRODUCTS

A. Products are as defined in the General Conditions.

B. Contractor shall not use and/or reuse materials and/or equipment removed from existing Premises, except as specifically permitted by the Contract Documents.

C. Contractor shall provide interchangeable components of the same manufacturer, for similar components.

1.03 TRANSPORTATION AND HANDLING

A. Contractor shall transport and handle Products in accordance with manufacturer's instructions.

B. Contractor shall promptly inspect shipments to confirm that Products comply with requirements, quantities are correct, and products are undamaged.

C. Contractor shall provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

A. Contractor shall store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Contractor shall store sensitive products in weather-tight, climate controlled enclosures.

B. For exterior storage of fabricated Products, Contractor shall place on sloped supports, above ground.

C. Contractor shall provide off-site storage and protection when Site does not permit on-site storage or protection.

D. Contractor shall cover products subject to deterioration with impervious sheet covering and provide ventilation to avoid condensation.

E. Contractor shall store loose granular materials on solid flat surfaces in a well-drained area and prevent mixing with foreign matter.

F. Contractor shall provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

G. Contractor shall arrange storage of Products to permit access for inspection and periodically inspect to assure Products are undamaged and are maintained under specified conditions.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 71 23

FIELD ENGINEERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Site Investigation, and Soils Investigation Report;

B. Special Conditions;

C. Site-Visit Certification.

1.02 REQUIREMENTS INCLUDED:

A. Contractor shall provide and pay for field engineering services by a California-registered engineer, required for the project, including, without limitations:

(1) Survey work required in execution of the Project.

(2) Civil or other professional engineering services specified, or required to execute Contractor's construction methods.

1.03 QUALIFICATIONS OF SURVEYOR OR ENGINEERS:

Contractor shall only use a qualified licensed engineer or registered land surveyor, to whom District makes no objection.

1.04 SURVEY REFERENCE POINTS:

A. Existing basic horizontal and vertical control points for the Project are those designated on the Drawings.

B. Contractor shall locate and protect control points prior to starting Site Work and preserve all permanent reference points during construction. In addition Contractor shall:

(1) Make no changes or relocation without prior written notice to District and Architect.

(2) Report to District and Architect when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

(3) Require surveyor to replace Project control points based on original survey control that may be lost or destroyed.

1.05 RECORDS:

Contractor shall maintain a complete, accurate log of all control and survey work as it progresses.

1.06 SUBMITTALS:

A. Contractor shall submit name and address of Surveyor and Professional Engineer to District and Architect prior to its/their work on the Project.

B. On request of District and Architect, Contractor shall submit documentation to verify accuracy of field engineering work, at no additional cost to the District.

C. Contractor shall submit a certificate signed by registered engineer or surveyor certifying that elevations and locations of improvements are in conformance or nonconformance with Contract Documents.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION

3.01 COMPLIANCE WITH LAWS:

Contractor is responsible for meeting all applicable codes, OSHA, safety and shoring requirements.

3.02 NONCONFORMING WORK:

Contractor is responsible for any re-surveying required by correction of nonconforming work.

END OF DOCUMENT

DOCUMENT 01 73 29

CUTTING AND PATCHING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Inspector, Inspections, and Tests, Integration of Work, Nonconforming Work, and Correction of Work, and Uncovering Work;

B. Special Conditions;

C. Hazardous Materials Procedures and Requirements;

D. Hazardous Materials Certification;

E. Lead-Based Paint Certification;

F. Imported Materials Certification.

1.02 CUTTING AND PATCHING:

A. Contractor shall be responsible for all cutting, fitting, and patching, including associated excavation and backfill, required to complete the Work or to:

(1) Make several parts fit together properly.

(2) Uncover portions of Work to provide for installation of ill-timed Work.

(3) Remove and replace defective Work.

(4) Remove and replace Work not conforming to requirements of Contract Documents.

(5) Remove Samples of installed Work as specified for testing.

(6) Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

(7) Attaching new materials to existing remodeling areas – including painting (or other finishes) to match existing conditions.

B. In addition to Contract requirements, upon written instructions from the District, Contractor shall uncover Work to provide for observations of covered Work in accordance with the Contract Documents; remove samples of installed materials for testing as directed by District; and remove Work to provide for alteration of existing Work.

C. Contractor shall not cut or alter Work, or any part of it, in such a way that endangers or compromises the integrity of the Work, the Project, or work of others.

1.03 SUBMITTALS:

A. Prior to any cutting or alterations that may affect the structural safety of Project, or work of others, and well in advance of executing such cutting or alterations, Contractor shall submit written notice to District pursuant to the applicable notice provisions of the Contract Documents, requesting consent to proceed with the cutting or alteration, including the following:

(1) The work of the District or other trades.

(2) Structural value or integrity of any element of Project.

(3) Integrity or effectiveness of weather-exposed or weather-resistant elements or systems.

(4) Efficiency, operational life, maintenance or safety of operational elements.

(5) Visual qualities of sight-exposed elements.

B. Contractor's Request shall also include:

(1) Identification of Project.

(2) Description of affected Work.

(3) Necessity for cutting, alteration, or excavations.

(4) Affects of Work on District, other trades, or structural or weatherproof integrity of Project.

(5) Description of proposed Work:

(a) Scope of cutting, patching, alteration, or excavation.

(b) Trades that will execute Work.

(c) Products proposed to be used.

(d) Extent of refinishing to be done.

(6) Alternates to cutting and patching.

(7) Cost proposal, when applicable.

(8) The scheduled date the Contractor intends to perform the Work and the duration of time to complete the Work.

(9) Written permission of District or other District contractor(s) whose work will be affected.

1.04 QUALITY ASSURANCE:

A. Contractor shall ensure that cutting, fitting, and patching shall achieve security, strength, weather protection, appearance for aesthetic match, efficiency, operational life, maintenance, safety of operational elements, and the continuity of existing fire ratings.

B. Contractor shall ensure that cutting, fitting, and patching shall successfully duplicate undisturbed adjacent profiles, materials, textures, finishes, colors, and that materials shall match existing construction. Where there is dispute as to whether duplication is successful or has been achieved to a reasonable degree, the District's decision shall be final.

1.05 PAYMENT FOR COSTS:

A. Cost caused by ill-timed or defective Work or Work not conforming to Contract Documents, including costs for additional services of the District, its consultants, including but not limited to the Construction Manager, the Architect, the Project Inspector(s), Engineers, and Agents, will be paid by Contractor and/or deducted from the Contract by the District.

B. District shall only pay for cost of Work if it is part of the original Contract Price or if a change has been made to the contract in compliance with the provisions of the General Conditions. Cost of Work performed upon instructions from the District, other than defective or nonconforming Work, will be paid by District on approval of written Change Order. Contractor shall provide written cost proposals prior to proceeding with cutting and patching.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Contractor shall provide for replacement and restoration of Work removed. Contractor shall comply with the Contract Documents and with the Industry Standard(s), for the type of Work, and the Specification requirements for each specific product involved. If not specified, Contractor shall first recommend a product of a manufacturer or appropriate trade association for approval by the District.

B. Materials to be cut and patched include those damaged by the performance of the Work.

PART 3 – EXECUTION

3.01 INSPECTION:

A. Contractor shall inspect existing conditions of the Site and the Work, including elements subject to movement or damage during cutting and patching, excavating and backfilling. After uncovering Work, Contractor shall inspect conditions affecting installation of new products.

B. Contractor shall report unsatisfactory or questionable conditions in writing to District as indicated in the General Conditions and shall proceed with Work as indicated in the General Conditions by District.

3.02 PREPARATION:

A. Contractor shall provide shoring, bracing and supports as required to maintain structural integrity for all portions of the Project, including all requirements of the Project.

B. Contractor shall provide devices and methods to protect other portions of Project from damage.

C. Contractor shall, provide all necessary protection from weather and extremes of temperature and humidity for the Project, including without limitation, any work that may be exposed by cutting and patching Work. Contractor shall keep excavations free from water.

3.03 ERECTION, INSTALLATION AND APPLICATION:

A. With respect to performance, Contractor shall:

(1) Execute fitting and adjustment of products to provide finished installation to comply with and match specified tolerances and finishes.

(2) Execute cutting and demolition by methods that will prevent damage to other Work, and provide proper surfaces to receive installation of repairs and new Work.

(3) Execute cutting, demolition excavating, and backfilling by methods that will prevent damage to other Work and damage from settlement.

B. Contractor shall employ original installer or fabricator to perform cutting and patching for:

(1) Weather-exposed surfaces and moisture-resistant elements such as roofing, sheet metal, sealants, waterproofing, and other trades.

(2) Sight-exposed finished surfaces.

C. Contractor shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes as shown or specified in the Contract Documents including, without limitation, the Drawings and Specifications.

D. Contractor shall fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Contractor shall conform to all Code requirements for penetrations or the Drawings and Specifications, whichever calls for a higher quality or more thorough requirement. Contractor shall maintain integrity of both rated and non-rated fire walls, ceilings, floors, etc.

E. Contractor shall restore Work which has been cut or removed. Contractor shall install new products to provide completed Work in accordance with requirements of the Contract Documents and as required to match surrounding areas and surfaces.

F. Contractor shall refinish all continuous surfaces to nearest intersection as necessary to match the existing finish to any new finish.

END OF DOCUMENT

DOCUMENT 01 76 00

ALTERATION PROJECT PROCEDURES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Integration of Work, Purchase of Materials and Equipment, Uncovering of Work and Non-conforming Work and Correction of Work and Trenches;

B. Special Conditions.

PART 2 - PRODUCTS

2.01 PRODUCTS FOR PATCHING AND EXTENDING WORK:

A. New Materials: As specified in the Contract Documents including, without limitation, in the Specifications, Contractor shall match existing products, conditions, and work for patching and extending work.

B. Type and Quality of Existing Products: Contractor shall determine by inspection, by testing products where necessary, by referring to existing conditions and to the Work as a standard.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Contractor shall verify that demolition is complete and that areas are ready for installation of new Work.

B. By beginning restoration Work, Contractor acknowledges and accepts the existing conditions.

3.02 PREPARATION:

A. Contractor shall cut, move, or remove items as necessary for access to alterations and renovation Work. Contractor shall replace and restore these at completion.

B. Contractor shall remove unsuitable material not as salvage unless otherwise indicated in the Contract Documents. Unsuitable material may

include, without limitation, rotted wood, corroded metals, and deteriorated masonry and concrete. Contractor shall replace materials as specified for finished Work.

C. Contractor shall remove debris and abandoned items from all areas of the Site and from concealed spaces.

D. Contractor shall prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.

E. Contractor shall close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity. Contractor shall insulate ductwork and piping to prevent condensation in exposed areas. Contractor shall insulate building cavities for thermal and/or acoustical protection, as detailed.

3.03 INSTALLATION:

A. Contractor shall coordinate Work of all alternations and renovations to expedite completion and to accommodate District occupancy.

B. Designated Areas and Finishes: Contractor shall complete all installations in all respects, including operational, mechanical work and electrical work.

C. Contractor shall remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring Products and finishes to original or specified condition.

D. Contractor shall refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat and square or straight transition to adjacent finishes.

E. Contractor shall install products as specified in the Contract Documents, including without limitation, the Specifications.

3.04 TRANSITIONS:

A. Where new Work abuts or aligns with existing, Contractor shall perform a smooth and even transition. Patched Work must match existing adjacent work in texture and appearance.

B. When finished surfaces are cut so that a smooth transition with new Work is not possible, Contractor shall terminate existing surface along a straight line at a natural line of division and make a recommendation for resolution to the District and the Architect for review and approval.

3.05 ADJUSTMENTS:

A. Where removal of partitions or walls results in adjacent spaces becoming one, Contractor shall rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

B. Where a change of plane of 1/4 inch or more occurs, Contractor shall submit a recommendation for providing a smooth transition to the District and the Architect for review and approval.

C. Contractor shall trim and seal existing wood doors and shall trim and paint metal doors as necessary to clear new floor finish and refinish trim as required.

D. Contractor shall fit Work at penetrations of surfaces.

3.06 REPAIR OF DAMAGED SURFACES:

A. Contractor shall patch or replace portions of existing surfaces, which are damaged, lifted, discolored, or showing other imperfections, in the area where the Work is performed.

B. Contractor shall repair substrate prior to patching finish.

3.07 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS:

A. Cultivated or planted areas and other surface improvements which are damaged by actions of the Contractor shall be restored by Contractor to their original condition or better, where indicated.

B. Contractor shall protect and replace, if damaged, all existing guard posts, barricades, and fences.

C. Contractor shall give special attention to avoid damaging or killing trees, bushes and/or shrubs on the Premises and/or identified in the Contract Documents, including without limitation, the Drawings.

3.08 FINISHES:

A. Contractor shall finish surfaces as specified in the Contract Documents, including without limitations, the provisions of all Divisions of the Specifications.

B. Contractor shall finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, Contractor shall refinish entire surface to nearest intersections.

3.09 CLEANING:

A. Contractor shall continually clean the Site and the Premises as indicated in the Contract Documents, including without limitation, the provisions in the General Conditions and the Specifications regarding cleaning.

END OF DOCUMENT

DOCUMENT 01 77 00

CONTRACT CLOSEOUT AND FINAL CLEANING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

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

A. General Conditions, including, without limitation, Completion of Work;

B. Special Conditions;

C. Temporary Facilities and Controls.

1.02 CLOSEOUT PROCEDURES

Contractor shall comply with all closeout provisions as indicated in the General Conditions.

1.03 FINAL CLEANING

A. Contractor shall execute final cleaning prior to final inspection.

B. Contractor shall clean interior and exterior glass and all surfaces exposed to view; remove temporary labels, tape, stains, and foreign substances, polish transparent and glossy surfaces, wax and polish new vinyl floor surfaces, vacuum carpeted and soft surfaces.

C. Contractor shall clean equipment and fixtures to a sanitary condition.

D. Contractor shall replace filters of operating equipment.

E. Contractor shall clean debris from roofs, gutters, down spouts, and drainage systems.

F. Contractor shall clean Site, sweep paved areas, and rake clean landscaped surfaces.

G. Contractor shall remove waste and surplus materials, rubbish, and construction facilities from the Site and surrounding areas.

1.04 ADJUSTING

Contractor shall adjust operating products and equipment to ensure smooth and unhindered operation.

1.05 RECORD DOCUMENTS AND SHOP DRAWINGS

A. Contractor shall legibly mark each item to record actual construction, including:

(1) Measured depths of foundation in relation to finish floor datum.

(2) Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permit surface improvements.

(3) Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

(4) Field changes of dimension and detail.

(5) Details not on original Contract Drawings

(6) Changes made by modification(s).

(7) References to related Shop Drawings and modifications.

B. Contractor will provide one set of Record Drawings to District.

C. Contractor shall submit all required documents to District and/or Architect prior to or with its final Application for Payment.

1.06 INSTRUCTION OF DISTRICT PERSONNEL

A. Before final inspection, at agreed upon times, Contractor shall instruct District's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. For equipment requiring seasonal operation, Contractor shall perform instructions for other seasons within six months or by the change of season.

C. Contractor shall use operation and maintenance manuals as basis for instruction. Contractor shall review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Contractor shall prepare and insert additional data in Operation and Maintenance Manual when the need for such data becomes apparent during instruction.

E. Contractor shall review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

A. Contractor shall provide products, spare parts, maintenance, and extra materials in quantities specified in the Specifications and in Manufacturer's recommendations.

B. Contractor shall provide District with all required Operation and Maintenance Data at one time. Partial or piecemeal submissions of Operation and Maintenance Data will not be accepted.

PART 2 – PRODUCTS Not used.

PART 3 – EXECUTION Not used.

END OF DOCUMENT

DOCUMENT 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Completion of the Work;

B. Special Conditions.

1.02 QUALITY ASSURANCE:

Contractor shall prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.03 FORMAT:

A. Contractor shall prepare data in the form of an instructional manual entitled “OPERATIONS AND MAINTENANCE MANUAL & INSTRUCTIONS” (“Manual”).

B. Binders: Contractor shall use commercial quality, 8-1/2 by 11 inch, three-side rings, with durable plastic covers; two inch maximum ring size. When multiple binders are used, Contractor shall correlate data into related consistent groupings.

C. Cover: Contractor shall identify each binder with typed or printed title "OPERATION AND MAINTENANCE MANUAL & INSTRUCTIONS"; and shall list title of Project and identify subject matter of contents.

D. Contractor shall arrange content by systems process flow under section numbers and sequence of Table of Contents of the Contract Documents.

E. Contractor shall provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

F. Text: The content shall include Manufacturer's printed data, or typewritten data on 24 pound paper.

G. Drawings: Contractor shall provide with reinforced punched binder tab and shall bind in with text; folding larger drawings to size of text pages.

1.04 CONTENTS, EACH VOLUME:

A. Table of Contents: Contractor shall provide title of Project; names, addresses, and telephone numbers of the Architect, any engineers, subconsultants, Subcontractor(s), and Contractor with name of responsible parties; and schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: Contractor shall list names, addresses, and telephone numbers of Subcontractor(s) and suppliers, including local source of supplies and replacement parts.

C. Product Data: Contractor shall mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

D. Drawings: Contractor shall supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Contractor shall not use Project Record Documents as maintenance drawings.

E. Text: The Contractor shall include any and all information as required to supplement product data. Contractor shall provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

F. Warranties and Bonds: Contractor shall bind in one copy of each.

1.05 MANUAL FOR MATERIALS AND FINISHES:

A. Building Products, Applied Materials, and Finishes: Contractor shall include product data, with catalog number, size, composition, and color and texture designations. Contractor shall provide information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Contractor shall include Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture Protection and Weather Exposed Products: Contractor shall include product data listing applicable reference standards, chemical composition, and details of installation. Contractor shall provide recommendations for inspections, maintenance, and repair.

D. Additional Requirements: Contractor shall include all additional requirements as specified in the Specifications.

E. Contractor shall provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS:

A. Each Item of Equipment and Each System: Contractor shall include description of unit or system, and component parts and identify function, normal operating characteristics, and limiting conditions. Contractor shall include performance curves, with engineering data and tests, and complete nomenclature, and commercial number of replaceable parts.

B. Panelboard Circuit Directories: Contractor shall provide electrical service characteristics, controls, and communications.

C. Contractor shall include color coded wiring diagrams as installed.

D. Operating Procedures: Contractor shall include start-up, break-in, and routine normal operating instructions and sequences. Contractor shall include regulation, control, stopping, shut-down, and emergency instructions. Contractor shall include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Contractor shall include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Contractor shall provide servicing and lubrication schedule, and list of lubricants required.

G. Contractor shall include manufacturer's printed operation and maintenance instructions.

H. Contractor shall include sequence of operation by controls manufacturer.

I. Contractor shall provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Contractor shall provide control diagrams by controls manufacturer as installed.

K. Contractor shall provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Contractor shall provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Contractor shall provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Additional Requirements: Contractor shall include all additional requirements as specified in Specification(s).

O. Contractor shall provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.07 SUBMITTAL:

A. Contractor shall submit to the District for review two (2) copies of preliminary draft or proposed formats and outlines of the contents of the Manual within thirty (30) days of Contractor's start of Work.

B. For equipment, or component parts of equipment put into service during construction and to be operated by District, Contractor shall submit draft content for that portion of the Manual within ten (10) days after acceptance of that equipment or component.

C. Contractor shall submit two (2) copies of a complete Manual in final form prior to final Application for Payment. Copy will be returned with Architect/Engineer comments. Contractor must revise the content of the Manual as required by District prior to District's approval of Contractor's final Application for Payment.

D. Contractor must submit two (2) copies of revised Manual in final form within ten (10) days after final inspection.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 78 36

WARRANTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

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

A. General Conditions, including, without limitation, Warranty/Guarantee Information;

B. Special Conditions.

1.02 FORMAT

A. Binders: Contractor shall use commercial quality, 8-1/2 by 11 inch, three-side rings, with durable plastic covers; two inch maximum ring size.

B. Cover: Contractor shall identify each binder with typed or printed title "WARRANTIES" and shall list title of Project.

C. Table of Contents: Contractor shall provide title of Project; name, address, and telephone number of Contractor and equipment supplier; and name of responsible principal. Contractor shall identify each item with the number and title of the specific Specification, document, provision, or section in which the name of the product or work item is specified.

D. Contractor shall separate each warranty with index tab sheets keyed to the Table of Contents listing, providing full information and using separate typed sheets as necessary. Contractor shall list each applicable and/or responsible Subcontractor(s), supplier(s), and/or manufacturer(s), with name, address, and telephone number of each responsible principal(s).

1.03 PREPARATION:

A. Contractor shall obtain warranties, executed in duplicate by each applicable and/or responsible subcontractor(s), supplier(s), and manufacturer(s), within ten (10) days after completion of the applicable item or work. Except for items put into use with District's permission, Contractor shall leave date of beginning of time of warranty blank until the date of completion is determined.

B. Contractor shall verify that documents are in proper form, contain full information, and are notarized, when required.

C. Contractor shall co-execute submittals when required.

D. Contractor shall retain warranties until time specified for submittal.

1.04 TIME OF SUBMITTALS:

A. For equipment or component parts of equipment put into service during construction with District's permission, Contractor shall submit a draft warranty for that equipment or component within ten (10) days after acceptance of that equipment or component.

B. Contractor shall submit for District approval all warranties and related documents within ten (10) days after date of completion. Contractor must revise the warranties as required by the District prior to District's approval of Contractor's final Application for Payment.

C. For items of work delayed beyond date of completion, Contractor shall provide an updated submittal within ten (10) days after acceptance, listing the date of acceptance as start of warranty period.

PART 2 - PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

GUARANTEE FORM

_____ ("Contractor") hereby agrees that the _____ _____ (“Work” of Contractor) which Contractor has installed for the MiraCosta Community College District ("District") for the following project:

PROJECT:_____

(“Project” or “Contract”) has been performed in accordance with the requirements of the Contract Documents and that the Work as installed will fulfill the requirements of the Contract Documents.

The undersigned agrees to repair or replace any or all of such Work that may prove to be defective in workmanship or material together with any other adjacent Work that may be displaced in connection with such replacement within a period of _____ year(s) from the date of completion as defined in Public Contract Code section 7107, subdivision (c), ordinary wear and tear and unusual abuse or neglect excepted. The date of completion is _____, 20___.

In the event of the undersigned’s failure to comply with the above-mentioned conditions within a reasonable period of time, as determined by the District, but not later than seven (7) days after being notified in writing by the District, the undersigned authorizes the District to proceed to have said defects repaired and made good at the expense of the undersigned. The undersigned shall pay the costs and charges therefor upon demand.

Date: _____

Proper Name of Contractor: __

Signature: _____

Print Name: _____

Title: _____

Representatives to be contacted for service subject to terms of Contract:

Name: _____

Address: _____

Phone No.: _____

Email: _____

END OF DOCUMENT

DOCUMENT 01 78 39

RECORD DOCUMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

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

A. General Conditions, including, without limitation, Documents on Work;

B. Special Conditions.

PART 2 - RECORD DRAWINGS

2.01 GENERAL:

A. Contractor shall maintain at each Project Site one set of marked-up plans and shall transfer all changes and information to those marked-up plans, as often as required in the Contract Documents, but in no case less than once each month. Contractor shall submit to the Project Inspector one set of the Project Record Drawings (“As-Builts”) showing all changes incorporated into the Work since the preceding monthly submittal. The As-Builts shall be available at the Project Site. The Contractor shall submit an electronic set and one (1) hard copy (or number as requested by the District) at the conclusion of the Project following review of the marked-up As-Builts.

B. Label and date each Record Drawing "RECORD DOCUMENT" in legibly printed letters.

C. All deviations in construction, including but not limited to pipe and conduit locations and deviations caused by without limitation Change Orders, Construction Claim Directives, RFI’s, and Addenda, shall be accurately and legibly recorded by Contractor.

D. Locations and changes shall be done by Contractor in a neat and legible manner and, where applicable, indicated by drawing a "cloud" around the changed or additional information.

2.02 RECORD DRAWING INFORMATION:

A. Contractor shall record the following information:

(1) Locations of Work buried under or outside each building, including, without limitation, all utilities, plumbing and electrical lines, and conduits.

(2) Actual numbering of each electrical circuit to match panel schedule.

(3) Locations of significant Work concealed inside each building whose general locations are changed from those shown on the Contract Drawings.

(4) Locations of all items, not necessarily concealed, which vary from the Contract Documents.

(5) Installed location of all cathodic protection anodes.

(6) Deviations from the sizes, locations, and other features of installations shown in the Contract Documents.

(7) Locations of underground work, points of connection with existing utilities, changes in direction, valves, manholes, catch basins, capped stubouts, invert elevations, etc.

(8) Sufficient information to locate Work concealed in each building with reasonable ease and accuracy.

In some instances, this information may be recorded by dimension. In other instances, it may be recorded in relation to the spaces in the building near which it was installed.

B. Contractor shall provide additional drawings as necessary for clarification.

C. Contractor shall provide reproducible record drawings, made from final Shop Drawings marked "No Exceptions Taken" or "Approved as Noted."

D. After review and approval of the marked-up specifications by the Project Inspector, Contractor shall provide electronic copies of the drawings (in PDF format) with one file with all of the sheets and one set of individual sheet files at the conclusion of the Project.

PART 3 - RECORD SPECIFICATIONS

3.01 GENERAL:

A. Contractor shall mark each section legibly to record manufacturer, trade name, catalog number, and supplier of each Product and item of equipment actually installed.

B. After review and approval of the marked-up specifications by the Project Inspector, Contractor shall provide one electronic copy of the specifications (in PDF format) at the conclusion of the Project.

PART 4 - MAINTENANCE OF RECORD DOCUMENTS

4.01 GENERAL

A. Contractor shall store Record Documents apart from documents used for construction as follows:

(1) Provide files and racks for storage of Record Documents.

(2) Maintain Record Documents in a clean, dry, legible condition and in good order.

B. Contractor shall not use Record Documents for construction purposes.

PART 5 – PRODUCTS Not Used.

END OF DOCUMENT

SECTION 02 41 19

SELECTIVE DEMOLITION

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.

1.02 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 01 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 01 73 29 Cutting and Patching procedures.

1.03 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.04 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.05 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.07 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.08 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.09 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

C. Sustainable Design Requirements for Building Reuse:

1. Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
2. Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
3. Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. N/A
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.02 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.03 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.04 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.05 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with Waste Reduction and Recycling Requirements in Supplemental Conditions.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area as designated by construction project manager.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition[**and cleaned**] and reinstalled in their original locations after selective demolition operations are complete.

3.06 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075410 Polyvinyl-Chloride (PVC) Roofing for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site [and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.] [and recycle or dispose of them according to comply with Waste Reduction and Recycling Requirements in Supplemental Conditions.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in comply with Waste Reduction and Recycling Requirements in Supplemental Conditions.

B. Burning: Do not burn demolished materials.

3.08 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.09 SELECTIVE DEMOLITION SCHEDULE

A. See the following sheets for demolition scope of work:

1. Architectural drawings:
   A0.01 – Demolition Site Plan
   A0.10 – Demolition Floor Plan
   A0.30 – Demolition Roof Plan
   A0.40 – Demolition Reflection Ceiling Plan
   A0.50 – Exterior Demolition Elevations
   A0.60 – Demolition Building Sections
   A0.70 – Interior Demolition Interior Elevations
2. Civil drawing:
   C1.1 – Site Demolition Plan
3. Landscape drawing:
   L0.01 – Landscape Demolition Plan
4. Mechanical drawings:
   MD2.11 – Demolition Floor Plan
   MD2.12 – Roof Demolition Plan
5. Electrical drawing:
   ED2.11 – Demolition Lighting Floor Plan
6. Electrical drawings:
   ED2.11 – Demolition Lighting Floor Plan
   ED2.21 - Demolition Power Floor Plan
7. Plumbing drawings:
   PD2.11 – Water Demolition Plan
   PD2.12 – Sewer and Vent Demolition Plan
8. Technology drawing:
   TD2.11 – Audiovisual Infrastructure Diagrams
9. Fire Alarm drawing:
   FA0.02 – Demolition Notes
10. Fire Protection drawing:
    FPD2.11 – Demolition Floor Plan
11. Security drawing:
    SE0.10 – Security Demolition Floor Plan

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Floors and slabs on grade.

C. Grade beams and footings.

D. Concrete reinforcement.

E. Joint devices associated with concrete work.

F. Miscellaneous concrete elements, including equipment pads.

G. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 033501 - Concrete Slab Finishing: Densifiers, hardeners, applied coatings, and polishing.

B. Section 079200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

C. Section 321313 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).

D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).

E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.

F. ACI 305R - Hot Weather Concreting; 2010.

G. ACI 306R - Cold Weather Concreting; 2010.

H. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).

I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).

J. ACI 347R - Guide to Formwork for Concrete; 2014.

K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.

L. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.

M. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2014a.

N. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.

O. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2016b.

P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.

R. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

S. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2016.

T. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2014.

U. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.

V. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

W. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.

X. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.

Y. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).

Z. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric); 2014.

AA. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.

1.04 SUBMITTALS

A. See Section 013300 - Submittals, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 318, Chapter 26.

D. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.

C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.
   1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.
   1. Acquire aggregates for entire project from same source.

C. Lightweight Aggregate: ASTM C330/C330M.

D. Fly Ash: ASTM C618, Class C or F.

E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

C. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
   1. Installation: Comply with ASTM E1643.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.

B. Epoxy Bonding System:
   1. Complying with ASTM C881/C881M and of Type required for specific application.

C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.

D. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.

2.07 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

C. Curing Agent, Water Replacement Type: Clear, water based, liquid water cure replacement agent complying with ASTM C309 standards for water retention, and with ACI 302.1R.

D. Moisture-Retaining Sheet: ASTM C171.
   1. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

E. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.

1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

C. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
3. Water-Cement Ratio: Maximum as indicated on drawings percent by weight.
4. Maximum Slump: as indicated on drawings inches.
5. Maximum Aggregate Size: as indicated on drawings inch.

D. Structural Lightweight Concrete:
1. Maximum dry unit weight: 115 lb per cubic foot.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
2. Use latex bonding agent only for non-load-bearing applications.

E. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect not less than 48 hours prior to commencement of placement operations.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting. See drawings for additional joint preperations as required.

G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, as indicated on the drawings.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values for on-grade slabs and elevated slabs before removal of shoring:
   1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15.
   2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15.
   3. Under Carpeting: F(F) of 25; F(L) of 20.
   4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25.
   5. Parking Structure: F(F) of 20; F(L) of 15, on-grade only.

B. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

C. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
   2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
   3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.

3.08 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.

C. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water-fog spray or saturated burlap.
      a. Spraying: Spray water over floor slab areas and maintain wet.
      b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   3. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
      b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.09 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014500 - Quality Control.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples as required per ACI 318 Section 5.6 and in accordance with ASTM C172/C172M.

E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.11 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 033501

CONCRETE SLAB FINISHING

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.

1.02 SUMMARY

A. Section Includes:

1. Concrete finishing and scoring of interior slabs where scheduled.
2. Concrete for concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Laboratory Test Reports: For liquid floor treatments, indicating compliance with requirements for low-emitting materials.

C. Samples for Verification: For each type of exposed color.

1.04 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Repair materials.
2. Stain materials.
3. Liquid floor treatments.

1.05 QUALITY ASSURANCE

A. Mockups: Apply surface treatment to slab area as directed by Architect to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Demonstrate curing, finishing, and protecting of concrete.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.01 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Concrete Finish: Penetrating clear sealer, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for concrete surfaces.

1. Basis of Design Product: Subject to compliance with requirements, provide W.R. Meadows, Inc., Liqui-Hard, or comparable product from one of the available manufacturers.
2. Available 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. Kaufman Products Inc.; SureHard: www.kaufmanproducts.net.
    b. Laticrete International, Inc.
    c. L&M Construction Chemicals, Inc.,
    d. MAPEI Corporation.
    e. SpecChem, LLC; Cure Hard: www.specchemllc.com/sle.
    f. SpecChem, LLC; SpecHard: www.specchemllc.com/sle.
    g. Or equal

3. Product Characteristics: Comply with the following:

    a. Achieve ‘High Traction Range’ readings when tested in accordance with ANSI B101.1 and ANSI B101.3.
    b. Coefficient of Friction: Greater than 0.60 dry, greater than 0.60 wet when tested in accordance with ASTM C1028.
    c. Stain Resistance: Achieve limited or no adverse effects when tested in accordance with ASTM D1308.
    d. Water Vapor Transmission: 100 percent retained when compared to untreated samples when tested in accordance with ASTM E96/96M Method B (Water Method).
    e. UV Stability: No degradation or yellowing of material when tested in accordance with ASTM G154.

4. 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

3.01 PREPARATION

A. Clean dirt, dust, oil, grease and other contaminants that interfere with penetration or performance of specified product from surfaces.

B. Remove remnants of curing compound, bond breaker, and construction laitance prior to application of densifier. Remove by cleaning and scrubbing in accordance with manufacturer's instructions.

C. Repair, patch and fill cracks, voids, defects and damaged areas in surface as approved by the Architect. Allow repair materials to cure completely before application of product.

D. Scrub floor with pre-densifier floor cleaner to remove latent salts.

E. Do not proceed until unsatisfactory conditions have been corrected.

3.02 SEALER APPLICATON

A. Newly placed concrete shall be at least 14 days old before sealing.

B. Prepare surfaces according to manufacturer's written instructions. 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 sealer manufacturer. Rinse until water is clear and allow surface to dry.

C. Application of water-based, penetrating oil and water protective treatment with a VOC content of 100 g/L or less:

1. Apply per manufacturer’s published recommendations to clean, dry slab at the completion of refining the slab surface with the high grit diamond impregnated burnishing system.
2. Apply saturating application at an estimated coverage rate of 400 to 800 square feet per gallon. Do not atomize.
3. Even out all puddles with a microfiber applicator before material has a chance to fully dry.
4. Do not burnish slab.

3.03 FINISHING REQUIREMENTS

A. Appearance: Interior exposed finished slab areas must consist of the following:

1. Slab surface must match the desired sheen and be consistent with approved Mock-up.
2. Slab surface must have a consistent look and exhibit a finish that has no evidence of streaking or burnish marks.
3. White residue or hazy appearance is not acceptable.

3.04 SLAB PROTECTION

A. Protect finished floors to prevent damage including staining, gouges and scratching by construction traffic and activities until possession.

B. Do not drag or drop equipment or material across the slab which will scratch or chip it.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

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.

1.02 SUMMARY

A. Section Includes:

1. Steel framing and supports for countertops.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Slotted channel framing.
4. Loose bearing and leveling plates for applications where they are not specified in other Sections.
5. Metal ladders.

1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions 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.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Slotted channel framing.

B. Sustainable Design Submittals: Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Show fabrication and installation details.[Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.] Provide Shop Drawings for the following:

1. Steel framing and supports for countertops.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research Reports: For post-installed anchors.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with 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."

1.07 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. 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. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 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. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. 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.
2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.079-inch nominal thickness.

2.03 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: 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 in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

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 B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.04 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting," and Section 09 91 23 "Interior Painting."

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. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. 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.

2.05 METAL LADDERS

A. General: Comply with ANSI A14.3.

B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 3/4-inch- (19-mm-) diameter, 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.
6. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
8. Galvanize and primeladders, including brackets.
9. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.

2.06 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.

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.

2.07 GENERAL FINISH REQUIREMENTS

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.

2.08 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products. 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 galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP2

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.

PART 3 - EXECUTION

3.01 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.

3.02 REPAIRS

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 055213
PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Free-standing railings at steps and ramps.

1.02 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; current edition.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; current edition.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; current edition.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; current edition.

E. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; current edition.

F. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; current edition.

G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); current edition.

H. San Diego Regional Standard Drawings; current edition

I. California Building Code, Title 24, Part 2, Volume 1 Chapter 11B; current edition.

1.03 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Submittals should include shop drawings and calculations that are stamped and signed by a registered civil or structural engineer.

PART 2 - PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

B. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

C. Allow for expansion and contraction of members and building movement without damage to connections or members.

D. Dimensions: See drawings for configurations and heights.

E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

1. For anchorage to concrete, provide inserts to be cast into concrete, for welding anchors.

F. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

G. 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.

H. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1 ½” minimum.

I. 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.

J. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1 1/4" minimum and 2" maximum.

K. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.

L. Handrails shall not rotate within their fittings.

M. 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.

N. A 2” minimum high curb or a barrier shall be provided to prevent the passage of a 4” diameter sphere rolling off the sides of a ramp surface. Such a curb or a barrier shall be continuous and uninterrupted along the length of a ramp. CBC Section 11B-405.9.2

2.02 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M, Grade B Schedule 80, black finish.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Galvanizing: In accordance with requirements of ASTM A123/A123M.

1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:

1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.

2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.

3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.
B. Structural composite lumber framing.
C. Non-structural dimension lumber framing.
D. Rough opening framing for doors, windows, and roof openings.
E. Sheathing.
F. Roof-mounted curbs.
G. Roofing nailers.
H. Roofing cant strips.
I. Preservative treated wood materials.
J. Miscellaneous framing and sheathing.
K. Communications and electrical room mounting boards.
L. Concealed wood blocking, nailers, and supports.
M. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Setting anchors in concrete.
B. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.
C. Section 092900 - Gypsum Board: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2015.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
E. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2015.
F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.
G. PS 1 - Structural Plywood; 2009.
H. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
I. PS 20 - American Softwood Lumber Standard; 2010.
J. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2004, and supplements.
K. WWPA G-5 - Western Lumber Grading Rules; 2011.

1.04 SUBMITTALS

A. See Section 013300 - Submittals, for submittal procedures.
B. Product Data: Provide technical data on wood preservative materials.
C. Structural Composite Lumber: Submit manufacturer's published structural data, marked to indicate which sizes and grades are being used; if structural composite lumber is being

substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.06 WARRANTY

A. See Section 017700 – Contract Closeout and Final Cleaning, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

C. Lumber salvaged from deconstruction or demolition of existing buildings or structures is permitted in lieu of sustainably harvested lumber provided it is clean, denailed, and free of paint and finish materials, and other contamination; identify source.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: West Coast Lumber Inspection Bureau; WCLIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Stud Framing (2 by 2 through 2 by 6):
   1. Species: Douglas Fir-Larch.
   2. Grade: as indicated on structural drawings.

E. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
   1. Species: Douglas Fir-Larch.
   2. Grade: as indicated on structural drawings.

F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, as indicated on structural drawings.

2.03 TIMBERS FOR CONCEALED APPLICATIONS

A. Grading Agency: West Coast Lumber Inspection Bureau; WCLIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry (19 percent maximum).

D. Beams and Posts 5 inches and over in thickness:
   1. Species: Douglas Fir-Larch.
   2. Grade: as indicated on structural drawings.

2.04 STRUCTURAL COMPOSITE LUMBER

A. At Contractor's option, structural composite lumber may be substituted for concealed dimension lumber and timbers.

B. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.

2.05 CONSTRUCTION PANELS

A. Roof Sheathing: Any PS-1 type, rated Structural I Sheathing.
   1. Bond Classification: Exposure 1.
   2. Span Rating: 24.
   3. Performance Category: 1/2 PERF CAT.

B. Wall Sheathing: Any PS-1 type.
   1. Bond Classification: Exposure 1.
   2. Grade: Structural I Sheathing.
   3. Span Rating: 16.
   4. Performance Category: 15/32 PERF CAT.
   5. Edge Profile: Square edge.

C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.06 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.

2.07 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
   1. Manufacturers:
      a. Lonza Group: www.wolmanizedwood.com/#sle.
      b. Koppers Performance Chemicals, Inc; www.koppersperformancechemicals.com/#sle.
      c. Viance, LLC; Preserve ACQ: www.treatedwood.com/#sle.
      d. Or Equal..
   2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.

a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
b. Treat lumber in contact with roofing, flashing, or waterproofing.
c. Treat lumber in contact with masonry or concrete.
d. Treat lumber less than 18 inches above grade.
e. Treat lumber in other locations as indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.

E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

E. Provide the following specific non-structural framing and blocking:
1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.

7. Wall paneling and trim.
8. Joints of rigid wall coverings that occur between studs.

3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. Nail panels to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.
   4. Size and Location: As indicated on drawings.

3.07 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 FIELD QUALITY CONTROL

A. See Section 014500 - Quality Control, for additional requirements.

3.09 CLEANING

A. Waste Disposal: Comply with the requirements of Section 017700 – Contract Closeout and Final Cleaning.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

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.

1.02 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.

B. Related Requirements: Section 06 16 00 "Sheathing" for sheathing, subflooring, and underlayment.

1.03 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.04 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.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Product Data: For installation adhesives, indicating VOC content.
3. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

1.05 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.06 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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

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 does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. 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.

2.03 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
3. Plywood backing panels.

2.04 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.
4. Utility shelving.

B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any species.

C. 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.

D. 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.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Screws for Fastening to Metal Framing: ASTM C1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.

2.06 METAL FRAMING ANCHORS

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation. Use for interior locations unless otherwise indicated.

B. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick. Use for wood-preservative-treated lumber and where indicated.

C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304. Use for exterior locations and where indicated.

2.07 MISCELLANEOUS MATERIALS

A. 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.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking,and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim. 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.

G. 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.

H. 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.

I. 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.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in 2019 CBC.
2. ICC-ES evaluation report for fastener.

L. 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.

3.02 INSTALLATION OF WOOD BLOCKING AND NAILER

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.

3.03 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring horizontally at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.04 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 miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, 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

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Parapet sheathing.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for plywood backing panels.
2. Section 07 27 15 "Nonbituminous Self-Adhering Sheet Air Barriers" for water-resistive barrier applied over wall sheathing.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.04 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.

B. Sustainable Design Submittals:

1. Product Data: For installation adhesives, indicating VOC content.
2. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.

    a. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
    b. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 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

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to other installed air barriers, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.02 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

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. Georgia-Pacific Gypsum LLC.
   c. National Gypsum Company.
   d. USG Corporation.
   e. Or equal.

2. Type and Thickness: Type X, 5/8 inch thick.

2.03 PARAPET SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

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. Georgia-Pacific Gypsum LLC.
   c. National Gypsum Company.
   d. USG Corporation.
   e. Or equal.

2. Type and Thickness: Type X, 5/8 inch thick.

2.04 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

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 Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

PART 3 - EXECUTION

3.01 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. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

D. 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.

3.02 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

3.03 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Prepare test and inspection reports.

END OF SECTION

SECTION 06 41 16

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

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.

1.02 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements: Section 06 10 53 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

C. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
4. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
5. Apply WI Certified Compliance Program label to Shop Drawings.

D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.

E. Samples for Initial Selection: For each type of exposed finish.

F. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required. Provide one sample applied to core material with specified edge material applied to one edge.
2. Thermoset Decorative Panels: 8 by 10 inches, for each color, pattern, and surface finish. Provide edge banding on one edge.
3. Corner Pieces:

a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
b. Miter joints for standing trim.

4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For each type of product.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.07 QUALITY ASSURANCE

A. Manufacturer's Qualifications: 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. Manufacturer's Certification: Licensed participant in WI's Certified Compliance Program.

B. Installer Qualifications: Licensed participant in WI's Certified Compliance Program.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, Code compliance for clearances, and to set quality standards for materials and execution.

1. Build mockups of typical architectural cabinets 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.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Record locations of concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
2. Identify conflicts with equipment rough-in and coordinate position adjustments as required.
3. Confirm that substrate surfaces and framing are plumb and within installation tolerances.

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.

PART 2 - PRODUCTS

2.01 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from WI certification program indicating that woodwork and installation complies with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality 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. Formica Corporation.
b. Abet Laminati Inc.
c. Lamin-Art, Inc.
d. Pionite; a Panolam Industries International, Inc. brand.
e. Wilsonart LLC.
f. Or equal.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

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. 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: As indicated by laminate manufacturer's designations.

2.02 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated. 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 architectural cabinet and quality grade specified unless otherwise indicated. Recycled Content of MDF and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Composite Wood Products: Products shall be made using ultra-low-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.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue. Basis of Design Manufacturer: Rodman Industries, Inc.
3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.

    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) Panel Source International, Inc.
        2) Sorm Incorporated.

4. Softwood Plywood: DOC PS 1.
5. Thermoset Decorative Panels: Particleboard or MDF 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.

2.03 CABINET HARDWARE AND ACCESSORIES

A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 170 degrees of opening, self-closing.

B. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

C. Catches: Push-in magnetic catches, ANSI/BHMA A156.9, B03131.

D. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

E. Drawer Slides: ANSI/BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted.

a. Type: Full extension.
b. Material: Zinc-plated 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 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
6. For computer keyboard shelves, provide Grade 1.
7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.

F. Door Locks: ANSI/BHMA A156.11, E07121.

G. Drawer Locks: ANSI/BHMA A156.11, E07041.

H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

I. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage. Color: Black.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated. 6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.04 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

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: 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."

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.05 FABRICATION

A. Fabricate architectural 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 architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's 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.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.02 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings 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.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with toggle bolts through metal backing or metal framing behind wall finish.

3.03 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade. Inspection entity shall prepare and submit report of inspection.

3.04 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. 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 PANELING

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.

1.02 SUMMARY

A. Section Includes: Plastic sheet paneling.

B. Related Requirements: Section 10 26 00 "Wall and Door Protection" for corner guards installed over plastic paneling.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.
4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For wall materials, indicating compliance with requirements for low-emitting materials.

C. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.04 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.05 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

2.01 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.02 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319. Panels shall be USDA accepted for incidental food contact.

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 Composites, Inc.
    b. Glasteel.
    c. Marlite.
    d. Newcourt, Inc.
    e. Nudo Products, Inc.
    f. Parkland Plastics, Inc.
    g. Or equal.

2. Verify wall materials 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."
3. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 200 or less.
    b. Smoke-Developed Index: 450 or less.

4. Nominal Thickness: Not less than 0.12 inch.
5. Surface Finish: Smooth.
6. Color: As selected by Architect from manufacturer's full range.

2.03 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. Color: As selected by Architect from manufacturer's full range.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer. Verify adhesives have a VOC content of 50 g/L or less.

E. Sealant: Mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants." Verify sealant has a VOC content of 250 g/L or less.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, 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.

3.02 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels and so that trimmed panels at corners are not less than 12 inches wide.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.
2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

D. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

E. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and 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 21 00

THERMAL INSULATION

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.

1.02 SUMMARY

A. Section Includes:

1. Glass-fiber blanket.
2. Glass-fiber board.
3. Mineral-wool blanket.
4. Mineral-wool board.
5. Loose-fill insulation.

B. Related Requirements: Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.03 SUBMITTALS

A. LEED Submittals: Product Data for Credit EQc2: For ceilings, walls, thermal, and acoustic insulation include product information sheet showing Reference standard CDPH Standard Method V1.1-2010 emission testing with TVOC range.

B. Product Data: For each type of product.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to 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

2.01 GENERAL:

A. Insulation materials shall achieve an R- value as indicated on Drawings, or if not indicated, an R-value of not less than 13.

2.02 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.03 GLASS-FIBER BOARD

A. Glass-Fiber Board, Unfaced: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics. Nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.04 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: 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, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.05 MINERAL-WOOL BOARD

A. Mineral-Wool Board, Types IA and IB, Unfaced: ASTM C 612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 4 lb/cu. ft..

2.06 LOOSE-FILL INSULATION

A. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type I for pneumatic application or Type II for poured application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

2.07 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Angle: Formed from 0.030-inch-thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

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. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

a. Crawl spaces.
b. Ceiling plenums.
c. Attic spaces.

D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.08 ACCESSORIES

A. Insulation for Miscellaneous Voids: Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.02 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.03 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install 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 the cavities, provide lengths that will produce a snug 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 not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials: Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

3.04 PROTECTION

A. Protect installed insulation 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 27 15

NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS

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.

1.02 SUMMARY

A. Section Includes: Self-adhering, vapor-permeable, nonbituminous sheet air barriers.

B. Related Requirements: Section 06 16 00 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.03 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

    a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
    c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.03 NONBITUMINOUS SHEET AIR BARRIER

A. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil-thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

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. Carlisle Coatings & Waterproofing Inc.
    b. GCP Applied Technologies Inc.
    c. Henry Company.
    d. VaproShield LLC.
    e. Or equal.

2. Physical and Performance Properties:

    a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
    b. Puncture Resistance: Minimum 40 lbf; ASTM E154/E154M.

c. Vapor Permeance: Minimum 15 perms; ASTM E96/E96M, Desiccant Method, Procedure A.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D4541 as modified by ABAA.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 50 days according to manufacturer's written instructions.

2.04 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

1. VOC Content: 250 g/L or less.
2. Low-Emitting Materials: Verify interior coatings 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. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

PART 3 - EXECUTION

3.01 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 substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.03 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic.

C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

F. CMU: Install air-barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.

1. Overlap horizontally adjacent sheets a minimum of 2 inches and roll seams.
2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
4. Continue the sheet into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.

G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch-wide, transition strip.

H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

J. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

K. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

L. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

M. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

N. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.

O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

P. Do not cover air barrier until it has been tested and inspected by testing agency.

Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.04 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.05 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 07 32 16

CONCRETE ROOF TILES

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.

1.02 SUMMARY

A. Section Includes:

1. Concrete roof tiles.
2. Underlayment materials.
3. Metal flashing and trim.

1.03 DEFINITIONS

A. Roofing Terminology: See ASTM D1079 and glossary in TRI/WSRCA's "Concrete and Clay Roof Tile Installation Manual" for definitions of terms related to roofing Work in this Section.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Concrete roof tiles.
2. Underlayment materials.
3. Asphalt roofing cement.
4. Butyl sealant.
5. Elastomeric sealant.
6. Mortar.
7. Eave closure.
8. Ridge closure.

B. Shop Drawings: For metal flashing and trim.

C. Samples: For each exposed product and for each color and texture specified, in sizes indicated.

1. Concrete Roof Tiles: Full size, showing full range of color values and blends.
2. Accessory Tiles: Full size, each type.
3. Metal Flashing: 12 inches square.

4. Eave Closures: In manufacturer's standard size.

1.06 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each type of concrete roof tile, based on evaluation of comprehensive tests performed by a qualified testing agency.

B. Research Reports: From ICC-ES, indicating that product is suitable for intended use under applicable building codes for the following:

1. Wire-tie tile-attachment systems.
2. Polymer-modified bitumen sheet underlayment.
3. Synthetic underlayment.

C. Sample Warranty: For manufacturer's materials warranty.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing to include in maintenance manuals.

B. Materials warranties.

C. Roofing Installer's warranty.

1.08 QUALITY ASSURANCE

A. 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 mockups for concrete roof tiles including related roofing materials. Size: 48 inches long by 48 inches wide.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Store underlayment rolls in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions. Store on end, on pallets or other raised surfaces. Do not double-stack rolls.

B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

C. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related work to be performed in accordance with manufacturer's written instructions and warranty requirements. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.11 WARRANTY

A. Materials Warranty: Manufacturer agrees to repair or replace concrete roof tiles that fail in materials within specified warranty period. Warranty Period: 50 years from date of Substantial Completion.

B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of concrete-tile roofing that fail in materials or workmanship within specified warranty period. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SOURCE LIMITATIONS

A. Obtain each type of product from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide concrete roof tiles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

B. Energy Performance, ENERGY STAR: Provide roof tiles that are listed on the DOE's "ENERGY STAR Roof Product List" for steep-slope roof products.

2.03 CONCRETE ROOF TILES

A. Concrete Roof Tiles: ASTM C1492, molded- or extruded-concrete roof tile units of shape and configuration indicated, with integral color, and free of surface imperfections. Provide with fastening holes prepunched at factory.

1. Basis of Design Product Subject to compliance with requirements, provide “Capistrano Series” roof tile manufactured by Eagle Roofing Products, or equal.:
2. Weight: Normal.
3. High-Profile Shape: Type I, Spanish or "S," interlocking. Accessory Tiles: Type IV units. Manufacturer’s standard profiles as required for complete installation.
4. Colors, Blends, and Patterns: Match Campus Standard tile color .

2.04 UNDERLAYMENT MATERIALS

A. Self-Adhering, Polymer-Modified Bitumen Sheet, High Temperature: ASTM D1970/D1970M, minimum 40-mil-thick sheet; glass-fiber-mat-reinforced, polymer-modified asphalt; with slip-resistant top surface and release backing; cold applied; and recommended in writing by manufacturer for use in tile roofing system required. Provide primer for adjoining concrete, masonry, and metal surfaces to receive underlayment.

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. Atlas Roofing Corporation.
   b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
   c. CertainTeed Saint-Gobain.
   d. GCP Applied Technologies Inc.
   e. Henry Company.
   f. Malarkey Roofing.
   g. Or equal.

2. Thermal Stability: Stable after testing at 240 deg F in accordance with ASTM D1970/D1970M.
3. Top Surface: Granule.

2.05 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.

B. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.

C. Elastomeric Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant of class and use classifications required to seal joints in concrete-tile roofing and remain watertight; recommended in writing by manufacturer for applications indicated.

D. Roofing Asphalt: ASTM D312/D312M Type IV.

E. Cold-Applied Adhesive: Manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with underlayments.

F. Mortar: ASTM C270, Type M, with ASTM C979/C979M, pigmented mortar matching the color of concrete roof tiles for exposed-to-view mortar, and natural color for concealed-from-view mortar.

G. Eave Closure: Manufacturer's standard galvanized-steel eave closure formed to shape of concrete roof tiles.

H. Ridge Closure: Manufacturer's standard EPDM ridge closure, formed to shape of concrete roof tiles.

I. Wood Nailers: Comply with requirements for pressure-preservative-treated wood in Section 06 10 53 "Miscellaneous Rough Carpentry."

J. Mesh Fabric: 18-by-14 mesh of PVC-coated, glass-fiber thread.

2.06 FASTENERS

A. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch-minimum diameter. Provide with minimum 0.0134-inch-thick metal cap, 0.010-inch-thick power-driven metal cap, or 0.035-inch-thick plastic cap; and with minimum 0.083-inch-thick ring shank or 0.091-inch-thick smooth shank of length to penetrate at least 3/4 inch into roof sheathing or to penetrate through roof sheathing less than 3/4 inch thick.

B. Nails for Wood Nailers: ASTM F1667; common or box, steel wire, flat head, and smooth shank.

2.07 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for design, dimensions, metal, and other characteristics of the item unless otherwise specified in this Section or indicated on Drawings.

1. Apron Flashings: Fabricate with lower flange extending a minimum of 6 inches over and 4 inches beyond each side of downslope tile roofing and 6 inches up the vertical surface.
2. Step Flashings: Fabricate with a headlap of 4 inches and a minimum extension of 5 inches both horizontally and vertically.
3. Channel Flashings: Fabricate with vertical surface extending a minimum of 5 inches above the concrete roof tile and 6 inches beneath the tile roofing, with a 1-inch-high vertical return to form a runoff channel.
4. Rake Pan Flashings: Fabricate with vertical surface extending over fasciae and 6 inches beneath the tile roofing, with a 1-inch-high vertical return to form a runoff channel.
5. Counterflashings: Fabricate to cover 4 inches of base flashing measured vertically; and in lengths required so that no step exceeds 8 inches and overall length is no more than 10 feet. Provide metal reglets for installation.
6. Valley Flashings: Fabricate from metal sheet not less than 24 inches wide in lengths not exceeding 10 feet, with 1-inch-Insert dimension high, inverted-V profile water diverter at center of valley and equal flange widths of not less than. Hem flange edges for fastening with metal cleats.
7. Drip Edges: Fabricate in lengths not exceeding 10 feet, with minimum 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge.

C. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof and extending at least 4 inches from pipe onto roof.

PART 3 - EXECUTION

3.01 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.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through roofing.
3. Verify that vent stacks and other penetrations through roofing are installed and securely fastened.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF UNDERLAYMENT MATERIALS

A. Comply with concrete-roof-tile and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings. Cover hip wood nailers with underlayment strips.

B. Self-Adhering, Polymer-Modified Bitumen Sheet: Install, wrinkle free.

1. Comply with low-temperature installation restrictions of underlayment manufacturer.
2. Install lapped in direction that sheds water.
3. Lap sides not less than 4 inches.
4. Lap ends not less than 6 inches, staggered 24 inches between succeeding courses.
5. Roll laps with roller.
6. Prime concrete, masonry, and metal surfaces to receive self-adhering, polymer-modified bitumen sheet.
7. Single-Layer Installation: Install over entire roof deck.
8. Cover underlayment within seven days.

C. Valley Underlayment: Install one layer of 36-inch-wide underlayment centered in valley, running full length of valley, and on top of underlayment on field of roof that is woven through valley. Install all layers of underlayment in and through valley tight with no bridging.

1. Use same underlayment as installed on field of roof.
2. Lap ends at least 12 inches in direction that sheds water, and seal with asphalt roofing cement.
3. Fasten to roof deck with underlayment nails located as far from valley center as possible and only to extent necessary to hold underlayment in place until installation of valley flashing.
4. Solidly cement valley underlayment to roof-field underlayment that is woven through valley using asphalt roofing cement.

3.03 INSTALLATION OF METAL FLASHING AND TRIM

A. Install metal flashings and other sheet metal to comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim." Install metal flashings in accordance with concrete-roof-tile manufacturer's written instructions and recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems."

B. Apron Flashings: Extend lower flange over and beyond each side of downslope tile roofing and up the vertical surface.

C. Step Flashings: Install with a headlap of 4 inches and extend both horizontally and vertically. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying tile. Fasten to roof deck only.

D. Cricket and Backer Flashings: Install against roof-penetrating elements, extending concealed flange beneath upslope tile roofing and beyond each side.

E. Channel Flashings: Install over underlayment materials and fasten to roof deck.

F. Rake Pan Flashings: Install over underlayment materials and fasten to roof deck.

G. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of 4 inches secured in a waterproof manner. Install in reglets or receivers.

H. Valley Flashings: Install centered in valleys, lapping ends at least 8 inches in direction that sheds water. Fasten upper end of each length to roof deck beneath overlap.

1. Secure hemmed flange edges into metal cleats spaced 12 inches apart and fastened to roof deck.
2. Adhere minimum 9-inch-wide strips of self-adhering, polymer-modified bitumen sheet to metal flanges and to underlying self-adhering, polymer-modified bitumen sheet. Place strips parallel to and over flanges so that they will be just concealed by installed tile.
3. Provide a closure at the end of the inverted-V profile of the valley metal to minimize water and ice infiltration.

I. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.

J. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.

K. Sheet Metal Ridge Vents: Install centered on and mechanically fasten to wood ridge. Adhere each side to concrete roof tile with elastomeric sealant. Install fabric mesh over roof-deck air ventilation gaps to prevent insect entry.

L. Pipe Flashings: Form flashing around pipe penetrations and tile roofing. Fasten and seal to tile roofing.

3.04 INSTALLATION OF WOOD NAILERS

A. Install wood nailers securely fastened to roof deck at the following locations:

1. Hips.
2. Ridges.
3. Rakes.

B. Install beveled wood-cant nailers at eaves and securely fasten to roof deck.

C. Install nominal 1-by-2-inch wood-batten nailers horizontally over 1/2-inch-high, pressure-preservative-treated wood lath strips in 48-inch lengths with ends separated by 1/2 inch, at spacing required by concrete-roof-tile manufacturer, and securely fasten to roof deck.

3.05 INSTALLATION OF CONCRETE ROOF TILES

A. Install concrete roof tiles in accordance with manufacturer's written instructions and recommendations in TRI/WSRCA's "Concrete and Clay Roof Tile Installation Manual" and NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" unless more stringent requirements are specified in this Section or indicated on Drawings.

1. Install tiles to resist wind forces resulting from design wind speeds indicated on Drawings.
2. Maintain uniform exposure and coursing of concrete roof tiles throughout roof.
3. Extend tiles 2 inches over eave fasciae.
4. Wire-Tie Fastening: Install wire-tie systems and fasten concrete roof tiles in accordance with manufacturer's written instructions.
5. Cut and fit concrete roof tiles neatly around roof vents, pipes, ventilators, and other projections through roof. Fill voids with mortar.
6. Install concrete roof tiles with color blend approved by Architect.

B. High-Profile Concrete-Roof-Tile Installation:

1. Install sheet metal eave closure.
2. Provide minimum 3-inch lap between succeeding courses of concrete roof tiles.
3. Install rake tiles indicated.
4. Install ridge tiles with laps facing away from prevailing wind. Seal laps with butyl sealant.

C. Closed Valleys: Cut concrete roof tiles at closed valleys to form straight lines, trimming upper concealed corners of tiles. Maintain uniform gap of 1/2 to 3/4 inch on either side of water diverter at valley centerline.

1. Drill or notch cut valley tiles and wire-tie to fastener placed clear of valley metal flashings.
2. Do not nail tiles to metal flashings.

D. Remove and replace damaged or broken concrete roof tiles.

END OF SECTION

SECTION 07 54 10

POLYVINYL-CHLORIDE (PVC) ROOFING

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.

1.02 SUMMARY

A. Section Includes:

1. Adhered polyvinyl chloride (PVC) roofing system.
2. Roof insulation.
3. Cover board.
4. Walkways.

B. Related Requirements:

1. Section 061053"Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 076200"Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 079200"Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.03 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet Owner, Architect, 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.

1.05 SUBMITTALS

A. Product Data: For each type of product. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work.

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation thickness and slopes.
5. Roof plan showing orientation of steel roof deck and 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.
7. Tie-in with air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashing, of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

E. Qualification Data: For Installer and manufacturer.

F. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article. 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.

G. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.

H. Evaluation Reports: For components of roofing system, from ICC-ES.

I. Field quality-control reports.

J. Sample Warranties: For manufacturer's special warranties.

K. Maintenance Data: For roofing system to include in maintenance manuals.

1.06 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.

1.07 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. 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.

1.08 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.

1.09 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.
2. Warranty Period: 30 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form acceptable to Owner, 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, vapor retarders, and walkway products, for the following warranty period: Warranty Period: Thirty years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 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 G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272/D 4272M, 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 wind uplift pressures 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 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-105.
2. Hail-Resistance Rating: SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

F. 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.

G. Exterior Fire-Test Exposure: ASTM E 108 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.

2.02 POLYVINYL CHLORIDE (PVC) ROOFING

A. PVC Sheet: ASTM D 4434/D 4434M, Type II, glass-fiber reinforced, felt backed.

1. Basis of Design Product: Subject to compliance with requirements, provide Sika Sarnafil; Sarnafil G410 roofing system, or comparable system from one of the following:

   a. Carlisle Syntech.
   b. GAF Materials Corp.
   c. Or equal.

2. Thickness: 80 mils.
3. Exposed Face Color: Grey.

B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.03 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. 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.

G. 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.

2.04 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Compressive Strength: 24 psi.
2. Size: 48 by 48 inches.
3. Thickness:

    a. Base Layer: 1-1/2 inches.
    b. Upper Layers: Number as required to obtain achieve R-value of roof/ceiling assembly.

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.05 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. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum board or ASTM C 1278/C 1278M fiber-reinforced gypsum board.

1. Thickness: 1/4 inch.
2. Surface Finish: Factory primed.

2.06 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pr rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer. Walkway Rolls: Sure-Flex Heat Weldable Walkway Rolls; 80 mils (0.080 inch) thick; gray membrane.

PART 3 - EXECUTION

3.01 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.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05310 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions. Submit test result within 24 hours of performing tests. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.03 ROOFING INSTALLATION, 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.

3.04 INSULATION INSTALLATION

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 Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

    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.
    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. 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 metal 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.
f. Trim insulation so that water flow is unrestricted.
g. Fill gaps exceeding 1/4 inch with insulation.
h. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
i. 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: Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Wood Panel Decking:

1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood panel decks.

   a. Fasten slip sheet according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
   b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows end joints staggered not less than 12 inches (305 mm) in adjacent rows.

   a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   c. 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 (610 mm). Trim insulation so that water flow is unrestricted.
   d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   f. Mechanically attach base layer of insulation 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 SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
      2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

3. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

   a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
   b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) 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 (6 mm) in width.
e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows: Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.05 INSTALLATION OF COVER BOARDS

A. 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. 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: Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.06 ADHERED ROOFING INSTALLATION

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 State'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. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. 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.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.07 BASE FLASHING INSTALLATION

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.

3.08 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

a. Top and bottom of each roof access ladder.
b. Locations indicated on Drawings.
c. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.09 FIELD QUALITY CONTROL

A. Perform the following tests:

1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

    a. Perform tests before overlying construction is placed.
    b. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
    c. Flood each area for 24 hours.
    d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight. Cost of retesting is Contractor's responsibility.
    e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of State’s Engineer, and to prepare inspection report.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 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 State’s Engineer and State.

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.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

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.

1.02 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.

B. Related Requirements: Section 06 10 53 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.

1.03 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 leakproof, secure, and noncorrosive installation.

1.04 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.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.05 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.

4. Epoxy seam sealer.

B. Sustainable Design Submittals: Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. 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 roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.

D. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

E. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.06 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.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.08 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. 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 mockup of typical roof coping, including fascia, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 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.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. 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 finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
   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

2.01 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, 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: 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.

C. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-105. Identify materials with name of fabricator and design approved by FM Approvals.

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. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Surface: Smooth, flat.
3. Exposed Coil-Coated Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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: Match cement plaster color.
5. Concealed 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.

2.03 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet Underlayment: 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 in accordance with underlayment 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. Carlisle WIP Products; a brand of Carlisle Construction Materials.
b. GCP Applied Technologies Inc.
c. Henry Company.
d. Owens Corning.
e. Protecto Wrap Company.
f. Or equal.

2. Source Limitations: Obtain underlayment from single source from single manufacturer.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.04 MISCELLANEOUS MATERIALS

A. 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.

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. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Coated (Galvanized Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
3. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Solder: For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

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. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

I. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

J. Reglets: Units of type, material, and profile 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. Material: Galvanized steel, 0.022 inch thick.
2. 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.
3. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
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.

6. Finish: With manufacturer's standard color coating.

2.05 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. 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.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. 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.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. 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.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

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:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

H. Do not use graphite pencils to mark metal surfaces.

2.06 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing: 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 Galvanized 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, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate from Galvanized Steel: 0.040 inch (1.02 mm) thick:

C. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch- long sections.
3. 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.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Expansion Joints: Butt type.

6. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.
7. Gutters: Fabricate from Galvanized Steel: 0.040 inch thick.

D. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from Galvanized Steel: 0.028 inch (0.71 mm) thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from Galvanized Steel: 0.022 inch (0.56 mm) thick.

F. Flashing Receivers: Fabricate from Galvanized Steel: 0.022 inch (0.56 mm) thick.

G. Roof-Penetration Flashing: Fabricate from Zinc: 0.032 inch (0.80 mm) thick

2.07 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from Galvanized Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION OF UNDERLAYMENT

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches.

B. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.

6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

C. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches.

3.03 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.
8. Do not use graphite pencils to mark metal surfaces.

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. 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.

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.

a. Form joints to completely conceal sealant.
b. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
c. 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 Sealants."

3.04 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor and loosely lock back edge of gutter to continuous cleat.
8. Anchor gutter with straps spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet (15.2 m) apart. Install expansion-joint caps.
10. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

3.05 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with 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:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

    a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
    b. 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.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant 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.

3.06 INSTALLATION OF MISCELLANEOUS FLASHING

A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.07 INSTALLATION 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.

3.08 CLEANING

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.

3.09 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. 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, as determined by Architect.

END OF SECTION

SECTION 07 84 13

PENETRATION FIRESTOPPING

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.

1.02 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in smoke barriers.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 “Submittal Procedures.”

B. Product Data: For each type of product.

C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency. 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.

D. Qualification Data: For Installer.

E. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

F. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.05 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.

1.06 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

2.01 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: Penetration firestopping systems shall bear classification marking of a qualified testing agency.

    a. UL in its "Fire Resistance Directory."
    b. Intertek Group in its "Directory of Listed Building Products."
    c. FM Global in its "Building Materials Approval Guide."

2.02 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. 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. 3M Fire Protection Products.
2. A/D Fire Protection Systems Inc.
3. Hilti, Inc.
4. Nelson FireStop Products: www.nelsonfirestop.com.
5. Specified Technologies, Inc.: www.stifirestop.com.
6. Or equal.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. 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. 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.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

E. 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.

2.03 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. 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.

G. 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.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.04 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

3.01 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.

3.02 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.

3.03 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. 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.

3.04 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. 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.

3.05 FIELD QUALITY CONTROL

A. Engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

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.

3.06 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

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Butyl joint sealants.
6. Latex joint sealants.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each joint-sealant 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. 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.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Field-Adhesion-Test Reports: For each sealant application tested.

D. Sample Warranties: For special warranties.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.07 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.

1.08 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following: Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

1. Disintegration of joint substrates from causes exceeding design specifications.
2. Mechanical damage caused by individuals, tools, or other outside agents.

3. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 JOINT SEALANTS, GENERAL

A. 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 joint-sealant manufacturer, based on testing and field experience.

B. VOC Content: Verify sealants and sealant primers comply with the following:

1. Architectural sealants have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates have a VOC content of 775 g/L or less.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 MANUFACTURERS

A. Subject to compliance with requirements, provide products manufactured by one of the following.

1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
2. Bostik Inc: www.bostik-us.com.
3. Dow Corning Corporation: www.dowcorning.com/construction/sle.
4. Tremco Global Sealants: www.tremcosealants.com.
5. Sika Corporation: www.usa-sika.com.
6. Or equal.

2.03 SILICONE JOINT SEALANTS

A. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.

2.04 URETHANE JOINT SEALANTS

A. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

2.05 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.06 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

2.07 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.08 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

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. Adfast.
b. Alcot Plastics Ltd.
c. BASF Corporation.
d. Construction Foam Products; a division of Nomaco, Inc.
e. Or equal.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.09 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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.

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.

3.03 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support 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 sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet 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.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below 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 sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C1193. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

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.

3.05 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

A. 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

    a. Isolation and contraction joints in cast-in-place concrete slabs.
    b. Joints between different materials listed above.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Joints between metal panels.
c. Joints between different materials listed above.
d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
e. Control and expansion joints in ceilings and other overhead surfaces.
f. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in tile flooring.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 07 92 19

ACOUSTICAL JOINT SEALANTS

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.

1.02 SUMMARY

A. Section includes acoustical joint sealants.

B. Related Requirements: Section 07 92 00 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.03 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

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. Samples for Verification: For each kind and color of acoustical 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.

D. Acoustical-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.04 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by a qualified testing agency.

B. Sample Warranties: For special warranties.

1.05 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90. Verify sealant has a VOC content of 250 g/L or less.

2.02 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

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. GE Construction Sealants; Momentive Performance Materials Inc.
    b. Hilti, Inc.
    c. Pecora Corporation.
    d. Tremco Incorporated.
    e. USG Corporation.
    f. Or equal.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

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. Serious Energy Inc.
    c. Or equal.

2.03 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. 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.

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.

3.03 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.04 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect acoustical 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, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

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.

1.02 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements: Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.03 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.04 COORDINATION

A. Coordinate anchorage installation 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.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.05 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Sustainable Design Submittals: Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
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 electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

D. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
2. Fabrication: Prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:

   a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly fire-rated borrowed-lite assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

C. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

D. Field quality control reports.

1.08 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.09 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following: Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following: Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.01 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. Ceco Door; ASSA ABLOY.
2. De La Fontaine Inc: www.delafontaine.com. Republic Doors: www.republicdoor.com..
3. Steelcraft, an Allegion brand: www.allegion.com/us. Technical Glass Products; SteelBuilt Window & Door Systems: www.tgpamerica.com.
4. Or equal.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.03 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C..

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.032 inch (0.8 mm).
   d. Edge Construction: Model 1, Full Flush.
   e. Core: Manufacturer's standard.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   b. Construction: Full profile welded with closed terminated stops.

3. Exposed Finish: Prime.

   a. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   b. Construction: Full profile welded.

2.04 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.
   d. Edge Construction: Model 1, Full Flush.
   e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
   f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
   g. Core: Manufacturer's standard.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
   b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.05 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.042 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.06 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.07 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.08 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

F. Power-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. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

2.09 FABRICATION

A. Door 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 or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite 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 welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, 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.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
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. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation 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.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.11 LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111, 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 or inverted-Y blades.
2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.01 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. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.02 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: 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 without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80, and their listing - p.

3. Floor Anchors: Secure with postinstalled expansion anchors. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames 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 and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.04 REPAIR

A. 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.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

ECTION 08 14 16

FLUSH WOOD DOORS

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.

1.02 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements: Section 08 80 00 "Glazing" for glass view panels in flush wood doors.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory-priming specifications.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating that product contains no urea formaldehyde.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For composite wood products, indicating that product contains no urea formaldehyde.
4. 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 type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Doors to be factory primed and application requirements.
8. Apply WI Certified Compliance Program label to Shop Drawings.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish.
2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
3. Louver blade and frame sections, 6 inches long, for each material and finish specified.
4. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.07 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in WI's Certified Compliance Program.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following: DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following: DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.08 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 bottom rail with opening number used on Shop Drawings.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed and weathertight, 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 remainder of construction period.

1.10 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. Delamination of veneer.
   b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   c. 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.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain flush wood doors from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2.03 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Provide certificates from WI certification program indicating that doors comply with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

B. Adhesives: Do not use adhesives that contain urea formaldehyde.

C. Adhesives: 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."

D. Composite Wood Products: Verify products are made without added urea formaldehyde.

E. Composite Wood Products: Verify products 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."

2.04 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors:

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. Eggers Industries: www.eggersindustries.com..
b. Graham Wood Doors: www.grahamdoors.com.Masonite Architectural.
c. Haley Brothers: www.haleybros.com.
d. Marshfield DoorSystems, Inc: www.marshfielddoors.com..
e. Oregon Door; Architectural Series: www.oregondoor.com/sle.
f. Or equal.

B. Interior Doors:

1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.
2. Architectural Woodwork Standards Grade: Premium.
3. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.

    a. Species: Select white maple.
    b. Cut: Quarter sliced.
    c. Match between Veneer Leaves: Book match.
    d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
    e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

4. Exposed Vertical Edges: Same species as faces - Architectural Woodwork Standards edge Type A. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
5. Core for Non-Fire-Rated Doors: Glued wood stave.
6. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.05 LIGHT FRAMES AND LOUVERS

A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

B. Metal Louvers:

1. Blade Type: Vision-proof, inverted V.
2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, with baked-enamel- or powder-coated finish.

C. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, with baked-enamel- or powder-coated finish.

2.06 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.

4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. 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 08 80 00 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.07 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish System - 1, Lacquer, Nitrocellulose.
3. Sheen: Satin.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

A. Hardware: For installation, see Section 08 71 00 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

3.03 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Provide inspection of installed Work through WI's Certified Compliance Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.04 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

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

B. Provide and install all access doors in walls and ceilings, whether shown on the Drawings or not, where required for access to Fire/Life Safety and/or MEP devices, valves and equipment. The door size must be appropriate for clear access, and the locations must be shown on the Coordination Drawings as approved by the State's Engineer before installation.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 "Submittals."

B. Product Data: For each type of product. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachment to other work. Provide coordination drawings indicating locations of access doors in reflected ceiling and floor plans.

D. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

E. Product Schedule: For access doors and frames. Provide complete schedule including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.02 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acudor Products, Inc.
   b. Babcock-Davis.
   c. JL Industries, Inc.; a division of the Activar Construction Products Group.
   d. Karp Associates, Inc.
   e. Lane-Aire Manufacturing Corp.
   f. Larsens Manufacturing Company.
   g. Or approved equal.

2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling. At exterior locations, provide weatherproof assembly, with face of door fit flush with frame and with exposed frame. Include extruded door gaskets and minimum 2-inch-thick fiberglass insulation.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed. Provide at all locations except as indicated otherwise.
5. Stainless-Steel Sheet for Door: Nominal 0.062 inch, 16 gage, No. 4 finish. Provide at Restrooms and similar locations containing plumbing fixtures.
6. Frame Material: Same material and thickness as door.
7. Latch and Lock: Latch bolt, key operated.

2.03 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
2. Locations: Wall and ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
5. Stainless-Steel Sheet for Door: Nominal 0.038 inch, 20 gage, No. 4 finish.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Self-closing, self-latching door hardware, operated by key.

2.04 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316. Remove tool and die marks and stretch lines, or blend into finish.

E. Frame Anchors: Same material as door face.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.05 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

2.06 FINISHES

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 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. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment. Primer shall be compatible with paint finishes specified in other Sections.

E. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates 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.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.03 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 33 13

COILING COUNTER DOORS

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.

1.02 SUMMARY

A. Section Includes: Counter door assemblies.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

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, and 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. Show locations of controls, locking devices, and other accessories.
5. 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. Curtain slats.
2. Bottom bar.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.05 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. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer. Obtain operators and controls from coiling counter door manufacturer.

2.02 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats. Basis of Design Product: Subject to compliance with requirements, provide Cornell, Model ESC10 counter door or comparable product from one of the following:

1. Clopay Building Products.
2. Cookson; a CornellCookson company.
3. Or equal.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. 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. Door Curtain Material: Aluminum.

D. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height. Comply with the following:

1. Aluminum**:** No. 1F, interlocked flat-faced slats, 1-1/2 inches high by 1/2 inch deep, minimum 0.050 inch aluminum with extruded tubular aluminum bottom bar with continuous lift handle and vinyl astragal.
2. Finish: Manufacturer’s SpectraShield® Coating System. Zirconium treatment followed by baked-on polyester powder coat, with color as selected by Architect from manufacturer's standard color range, over 180 colors; minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness: H or better.
3. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated aluminum extrusion and finished to match door.

F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Hood: Match curtain material and finish.

1. Shape: Square.
2. Mounting: Face of wall.

H. Sill Configuration: No sill.

I. Electric Door Operator:

1. Usage Classification: Light duty, up to 10 cycles per hour.
2. Operator Location: Wall.
3. Motor Exposure: Interior.
4. Motor Electrical Characteristics:

a. Horsepower: 1/2 hp.
b. Voltage: 115-V ac, single phase, 60 Hz.

5. Emergency Manual Operation: Crank type.
6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar. Sensor Edge Bulb Color: Black.
7. Control Station(s): Interior-side mounted.

J. Curtain Accessories: Equip door with weatherseals and poll hook].

2.03 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC , by a qualified testing agency, and marked for intended location and application.

2.04 DOOR CURTAIN MATERIALS AND FABRICATION

A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.05 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

2.06 CURTAIN ACCESSORIES

A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

B. Pole Hooks: Provide pole hooks and poles for doors more than 84 inches high.

2.07 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.08 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 CEC
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with CEC 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 Location(s): Operator location indicated for each door. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.

D. Motors: Reversible-type motor for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. 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.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each 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 Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. Electric Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

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." Type: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.09 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 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.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION, GENERAL

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 , NFPA 10 and CBC.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.

3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.05 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 seals to provide tight fit around entire perimeter.

3.06 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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.

1.02 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

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.
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.
6. Environmental Product Declaration: For each product.
7. Health Product Declaration: For each product.
8. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

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 type of 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.
3. Expansion provisions.
4. Glazing.
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.

1.05 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

B. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and acceptable to Owner and Architect.

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. 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.

1.08 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as directed by Architect.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
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.

1.09 WARRANTY

A. Special Warranty: Manufacturer and Installer agree 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: Ten years from date of Substantial Completion.

B. 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 D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, peeling, or chipping.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

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, twist, column shortening, long-term creep, 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:

1. Wind Loads: As indicated on Structural Drawings.
2. Other Design Loads: As indicated on Structural Drawings.

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite 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.
3. Cantilever Deflection: Where framing members overhang an anchor point, as follows: Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans of less than 11 feet 8-1/4 inches.

D. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and 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. Water Penetration under Static Pressure: Test according to ASTM E331 as follows: No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

F. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to 2019 CBC. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.

G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor): Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Air Leakage:

    a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested according to ASTM E283.
    b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

3. Condensation Resistance Factor (CRF): Fixed Glazing and Framing Areas: CRF for the system of not less than 70 as determined according to AAMA 1503.

H. Noise Reduction: Test according to ASTM E90, with ratings determined by ASTM E1332, as follows. Outdoor-Indoor Transmission Class: Minimum 30.

I. 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.

J. Structural-Sealant Joints: Designed to carry gravity loads of glazing.

K. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed, aluminum-framed entrances and storefronts without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.03 STOREFRONT SYSTEMS

A. Basis of Design and Permit Approval: Subject to compliance with requirements, provide Arcadia, Inc. product as indicated on Drawings.

B. Other Acceptable Manufacturers (Substitutions):

1. Substitutions:

a. Substitution may or may not be accepted after Architect and Owner review with complete evaluation for content and schedule impact.
b. Substitutions shall include all costs for redesign with consequential changes by other Contractor trades along with the Architect and related approvals by governing agencies.

1) Revisions to shop drawings illustrating the proposed changes is not considered adequate for DSA review and approval.
2) A minimum fee of $10,000.00 for DSA review processing by the Architect will need to be included for DSA review of any substituted system other than the basis of design.
3) An additional minimum allowance of $10,000.00 is required for Architects time to review the substituted system prior to submitting for governing agency approval.
4) The indicated fee amounts are minimums. These are subject to increase pending Architect and Agency reviews of the proposed substitution.

c. Substitutions may be acceptable, based on Architect's review and approval, for submittal to DSA. If substituted manufacturer cannot reproduce DSA design and approval in a timely manner, then they shall be subject to a time and material back charge for any delays in the project. Architect approval is required prior to DSA submittal and DSA approval is required prior to installation.

C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Clear anodic finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.04 ENTRANCE DOOR SYSTEMS

A. Basis of Design Product: Subject to compliance with requirements, provide Arcadia WS512D entrance door system.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch nominal width. Bottom Rail: 10 inch height minimum.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets. Provide nonremovable glazing stops on outside of door.
4. Finish: Match adjacent storefront framing finish.

2.05 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

2.06 GLAZING

A. Glazing: 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.

C. Glazing Sealants: Comply with Section 08 80 00 "Glazing."

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."

2.07 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: 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.

G. Regional Materials: Products shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

2.08 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding 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. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system , fabricated from 300 series stainless steel.

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. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, complying with ASTM A240/A240M, of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

E. Rigid PVC Filler.

2.09 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 exterior.
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: Fabricate components for assembly using shear-block system.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware. At interior and exterior doors, provide compression weather stripping at fixed stops.

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. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. 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.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 92 00 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.03 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 80 00 "Glazing."

3.04 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, according to sealant manufacturer's written instructions, to produce weatherproof joints.

3.05 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance 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.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.06 ERECTION TOLERANCES

A. 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.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Testing will include representative areas of aluminum-framed entrances and storefronts.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of three tests in areas as directed by Architect.
b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

a. Perform a minimum of three tests in areas as directed by Architect.
b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.08 MAINTENANCE SERVICE

A. Entrance Door Hardware Maintenance: Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

END OF SECTION

SECTION 08 45 13

STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

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.

1.02 SUMMARY

A. Section includes aluminum-framed assemblies glazed with structured-polycarbonate panels as follows: Canopy assemblies.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.

B. Sustainable Design Submittals:

C. Shop Drawings: For panel assemblies.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

D. Samples: In manufacturer's standard size.

1. For each type of structured-polycarbonate panel.
2. For each type of exposed finish for framing members.

E. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch lengths of full-size framing members and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Structured-polycarbonate panels.
5. Flashing and drainage.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each structured-polycarbonate-panel assembly, for tests performed by a qualified testing agency.

B. Evaluation Reports: For structured-polycarbonate-panel assemblies from ICC-ES.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies 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. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Water leakage.

2. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace structured-polycarbonate panels that exhibit defects in materials or workmanship within specified warranty period.

1. Defects include, but are not limited to, the following:

a. Delamination.
b. Color changes exceeding requirements.
c. Losses in light transmission beyond 6 percent from original when measured according to ASTM D1003.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Loads: As indicated on Drawings.

B. Deflection Limits: Overhead Panel Assemblies: Limited to 1/180 of clear span for each assembly component.

C. Structural-Test Performance: Panel assemblies tested according to ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified deflection limits.
2. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar-Heat-Gain Coefficient (SHGC): Fixed glazing and framing areas shall have an SHGC of no greater than 0.7 as determined according to NFRC 200.

2.02 STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

A. Structured-Polycarbonate-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with structured-polycarbonate panels.

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. Palram “Sunglaze” system (Basis of Design).
b. CPI Daylighting, Inc.
c. Duo-Gard Industries Inc.
d. Super Sky Products Inc.
e. Wasco - Part of VELUX Commercial.
f. Or equal.

2.03 STRUCTURED-POLYCARBONATE PANELS

A. Structured-Polycarbonate Panels: Translucent, extruded-polycarbonate sheet with multiwall cellular cross section that provides isolated airspaces and that is coextruded with a UV-protective layer.

B. Panel Thickness: As indicated on Drawings..

C. UV Resistance: On outer surface.

D. Color: As selected by Architect from manufacturer's full range.

E. Panel Performance:

1. Plastic Self-Ignition Temperature: 650 deg F or more according to ASTM D1929.
2. Smoke-Developed Index: 450 or less according to ASTM E84, or 75 or less according to ASTM D2843.
3. Combustibility Classification: Class CC1 based on testing according to ASTM D635.
4. Roof-Covering Classification: Class A according to ASTM E108 or UL 790.
5. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435. Outdoor Weathering Conditions: 60 months in Arizona or 120 months in a moderate North American climate.
6. Impact Resistance: No failure at impact of 200 ft. x lbf according to freefalling-ball impact test using a 3-1/2-inch-diameter, 6.3-lb ball.
7. Haze Factor: Greater than 90 percent when tested according to ASTM D1003.

2.04 ALUMINUM FRAMING SYSTEMS

A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads. Construction: One piece, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
3. Extruded Structural Pipe and Tubes: ASTM B429.
4. Structural Profiles: ASTM B308.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A193, 300 series stainless-steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 or ASTM A153 requirements.

F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Aluminum sheet not less than 0.040 inch thick, finished to match framing.

I. Framing Gaskets: Manufacturer's standard gasket system with low-friction surface treatment designed specifically for retaining structured-polycarbonate panels.

J. Frame-System Sealants: As specified in Section 07 92 00 "Joint Sealants."

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.05 FABRICATION

A. Fabricate aluminum 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. Internal guttering systems or other means to drain water passing through joints and moisture migrating within assembly to exterior.

B. Fabricate aluminum sill closures with weep holes and for installation as continuous component.

C. Reinforce aluminum components as required to receive fastener threads.

2.06 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Color and Gloss: Match Architect's sample.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, 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.

3.02 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

3.03 FIELD QUALITY CONTROL

A. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 08 62 00

UNIT SKYLIGHTS

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.

1.02 SUMMARY

A. Section Includes: Tubular daylighting devices.

B. Related Requirements: Section 08 45 13 "Structured-Polycarbonate-Panel Assemblies" for metal-framed skylights glazed with translucent insulating panels.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include product dimensions, construction details, material descriptions, dimensions and profiles of components, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, mounting, and attachment details and methods of structural support.
2. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and finish specified.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type and size of product, for tests performed by a qualified testing agency on specimens equal to or greater than sizes required for Project.

B. Evaluation Reports: Indicating product compliance with code requirements of authorities having jurisdiction.

C. Field quality-control reports.

D. Sample Warranty: For special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For products and accessories to include in maintenance manuals.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Water leakage not controlled by drainage features.
c. Deterioration of materials and finishes beyond normal weathering.
d. Yellowing of acrylic glazing.
e. Breakage of polycarbonate glazing.
f. Deterioration of insulating-glass units including failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating-glass units contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

2. Warranty Period: Products and Accessories: Ten years from date of Substantial Completion.

B. Special Aluminum Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of finish deterioration 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, checking, or chipping.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Performance Standard: Comply with AAMA/WDMA/CSA 101/1.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Label Requirements: Label each product with names of manufacturer and labeling agency and AAMA/WDMA/CSA 101/1.S.2/A440 product designation, performance grade, and test specimen size equal to or greater than the size of the product.
2. Certification Requirements: Provide AAMA certified products, with label attached to each.

B. Thermal Transmittance: NFRC 100 maximum U-factor of 0.55 Btu/sq. ft. x h x deg F.

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC of 0.40.

D. Plastic Glazing:

1. Self-Ignition Temperature: 650 deg F or more for plastic sheets in thickness indicated when tested in accordance with ASTM D1929.
2. Smoke-Production Characteristics: Smoke-developed index of 450 or less when tested in accordance with ASTM E84, and smoke density of 75 or less when tested in accordance with ASTM D2843.
3. Combustibility Characteristics: Tested in accordance with ASTM D635 and classified for burning rate of nominal thickness of 0.060 inch or thickness of plastic glazing indicated for use as follows:

    a. Class CC1: Burning rate of 1 inch per minute or less.
    b. Class CC2: Burning rate of 2-1/2 inches per minute or less.

E. Exterior Fire-Test Exposure: Provide products identical to those of assemblies tested for Class B fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

2.02 TUBULAR DAYLIGHTING DEVICES

A. Tubular Daylighting Device: Complete with exterior glazed opening, glazing retainers and gaskets, exterior flashing assembly, reflective tube, interior diffuser assembly, and components and accessories required to provide a complete installation.

B. Basis of Design Product: Subject to compliance with requirements, provide Solatube International, Inc., SolaMaster Series® 750 DS-C tubular daylighting system with OptiView® Diffuser, and Natural Effect Lens.

C. Product Type: AAMA/WDMA/CSA 101/1.S.2/A440.

D. Nominal Reflective Tube Diameter: 21 inches.

E. Exterior Glazing: Manufacturer's standard double dome.

1. Size: As required to coordinate with reflective tube.
2. Material:

    a. Acrylic: ASTM D4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber); and Class CC2 based on testing in accordance with ASTM D635.
    b. Minimum Thickness: 0.125 inch.

3. Seal: Manufacturer's standard.
4. Exterior Glazing Accessories:

    a. Fire-Protection Band: Dome edge-protection band matching flashing material and finish. Domes installed with fire-protection band pass Class B burning brand tests when tested in accordance with ASTM E108.

b. Secondary Diffuser Below Dome: Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear). Quality-Q3. Thickness: 3 mm.

F. Exterior Flashing: Manufacturer's standard one-piece, self-mounted type.

1. Size: As required to coordinate with exterior glazing and reflective tube.
2. Material: Manufacturer's standard corrosion-resistant metal and finish.
3. Tube Attachment: Manufacturer's standard receiver attached to top of roof flashing and serving as mounting base for dome assembly; provides thermal break between flashing and reflective tube; configured to channel condensed moisture to the exterior. Seal: Manufacturer's standard that provides weathertight seal with roof flashing.

G. Reflective Tube:

1. Rigid Tube: Light shaft formed from aluminum sheet, ASTM B209, with manufacturer's standard specular interior finish.

a. Thickness: Manufacturer's standard.
b. Length and Configuration: As indicated on Drawings.
c. Fastening System: Manufacturer's standard that provides tight mating of interconnecting tube component pieces.

2. Tube Accessories:

a. Suspension Wire: Manufacturer's standard to provide bracing of tube to structure as required for a fully supported installation.
b. Ceiling Trim: Manufacturer's standard trim for ceiling opening.
c. Trim Ring: Manufacturer's standard trim that covers the cut edge of the roof deck penetration.

H. Interior Diffuser: Assembly attached to bottom of reflective tube, with high-visible-light-transmittance lens.

1. Size: As required to coordinate with reflective tube.
2. Lens Type: Round, prismatic lens, polycarbonate Class CC1 based on testing in accordance with ASTM D635. Metal Trim Finish: White.

I. Accessories: Daylight Dimmer: Manufacturer's standard dimmer baffle, low-voltage, programmable, and complete with 12 V DC dimming control switch and 20 W low-voltage transformer.

2.03 ACCESSORY MATERIALS

A. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal that is compatible with the materials being fastened and as recommended in writing by manufacturer. Finish exposed fasteners to match material being fastened. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, 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.

3.02 INSTALLATION

A. Coordinate installation of products and accessories with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Install products and accessories to comply with recommendations in AAMA 1607 and with manufacturer's written installation instructions.

C. Install products true to line and without distortion.

D. Anchor products securely to supporting substrates.

E. Where metal surfaces of products will contact other metal or corrosive substrates, such as preservative-treated wood, apply bituminous coating on concealed metal surfaces or provide other approved permanent separation recommended in writing by manufacturer.

3.03 FIELD QUALITY CONTROL

A. After completion of installation and nominal curing of sealant and glazing compounds, but before installation of interior finishes, test for water leaks in accordance with AAMA 501.2.

B. Perform test for total area of each installed product.

C. Work will be considered defective if it does not pass tests and inspections.

D. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.04 CLEANING AND ADJUSTING

A. Clean exposed product surfaces in accordance with manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect product surfaces from contact with contaminating substances resulting from construction operations.

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.
6. Battery-powered electronic credential access control locks and panic hardware lever trim.
7. Inpact system frame/door/hardware assembly.
8. Card Access control system.
9. Hand-key biometric access control devices.
10. Hold-open closers with fire-alarm interface.
11. Wall or floor-mounted electromagnetic hold-open devices.
12. Power supplies for electric hardware.
13. Low energy door operators plus sensors and actuators.
14. Remote button release hardware.
15. Door position switches.
16. Cabinet locks.
17. Padlocks.
18. Cylinders for doors fabricated with locking hardware.
19. Stainless steel guard rails between pairs of exterior doors.
20. Point-to-point wiring diagrams for electric hardware.
21. Key cabinets.
22. Key management software.

B. Related Divisions:

1. Division 06 – door hardware installation
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 and glazed curtainwall systems.
4. Division 10 – operable partitions
5. Division 21 – fire and life safety systems
6. Division 28 – security access systems

C. Allowances:

1. Procure scheduled Best brand temporary and permanent cylinder cores and keys from (Owner's lock shop / Owner's Physical Plant Maintenance Dept). Allow $45 per core and $7.50 per key. Owner's agent will purchase the cores and keys directly from Best Access Systems or provide the units from Owner's attic stock.

D. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

2. Windows.

3. Cabinets, including open wall shelving and locks.
4. Signs, except where scheduled.
5. Toilet accessories, including grab bars.
6. Installation.
7. Rough hardware.
8. Conduit, junction boxes & wiring.
9. Sliding aluminum doors, except cylinders where detailed.
10. Access doors and panels, except cylinders where detailed.
11. Corner Guards.

1.2 REFERENCES:

A. Use date of standard in effect as of Bid date.

1. American National Standards Institute

a) ANSI 156.18 – Materials and Finishes.
b) ICC/ANSI A117.1 - 2009 – Specifications for making buildings and facilities usable by physically handicapped people. [omit for CA work – not applicable]

2. BHMA – Builders Hardware Manufacturers Association
3. 2019 California Building Code

a) Chapter 11B – Accessibility To Public Buildings, Public Accommodations, Commercial Buildings and Public Housing

4. DHI – Door and Hardware Institute
5. NFPA – National Fire Protection Association

a) NFPA 80 2016 Edition – Standard for Fire Doors and Other Opening Protectives.
b) NFPA 105 – Smoke and Draft Control Door Assemblies
c) NFPA 252 – Fire Tests of Door Assemblies

6. UL – Underwriters Laboratories

a) UL10C – Positive Pressure Fire Tests of Door Assemblies.
b) UL 305 – Panic Hardware

7. WHI – Warnock Hersey Incorporated State of California Building Code
8. Local applicable codes
9. SDI – Steel Door Institute
10. WI – Woodwork Institute
11. AWI – Architectural Woodwork Institute
12. NAAMM – National Association of Architectural Metal Manufacturers

B. Abbreviations

1. Manufacturers: see table at 2.1.A of this section
2. Finishes: see 2.7 of this section.

1.3 SUBMITTALS & SUBSTITUTIONS

A. SUBMITTALS: Submit six copies of schedule per D. Only submittals printed one sided 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.
13. Date of jobsite visit.

B. Bid and submit manufacturer's updated/improved item if scheduled item is discontinued.

C. 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.

D. 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.

E. Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.

F. Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.

G. 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 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 Owner's representative.

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.

E. Prior to submittal, carefully inspect existing conditions to verify finish hardware required to complete Work, including sizes, quantities, existing hardware scheduled for re-use, and sill condition material. If conflict between the specified/scheduled hardware and existing conditions, submit request for direction from Architect. Include date of jobsite visit in the submittal.

1. Submittals prepared without thorough jobsite visit by qualified hardware expert will be rejected as non-compliant.

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.

1.9 REGULATORY REQUIREMENTS: (Code citations are CBC 2019)

A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per 2019 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. 2019 California Building Code Section 11B-309.4.
2. Force required to activate the operable parts: 5.0 pounds maximum, per 2019 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 2019 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.

D. Low-energy powered doors: comply with ANSI/BHMA A156.19. Reference: 2019 California Building Code Section 11B-404.2.9.

1. Where powered door serves an occupancy of 100 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 2019 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 2019 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 2019 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 2019 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. 2019 California Building Code Section 11B-404.2.3.

1. Exception: doors not requiring full passage through the opening, that is, to spaces less than 24 inches in depth, may have the clear opening width reduced to 20 inches. Example: shallow closets.
2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2019 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 2019 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). 2019 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 2019 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. 2019 California Building Code, Section 1005.7.1.

2. In I-2 occupancies, surface mounted latch release hardware, mounted to the side of the door facing away from the adjacent wall where the door I sin the open position, is not exempt from the inclusion in the 7-inch maximum encroachment, regardless of its mounting height, per 2019 California Building Code, Section 1005.7.1 at Exception 1.

L. New buildings that are included in public schools (kindergarten through 12th grade) state funded projects and receiving state funding pursuant to Leroy F. Green, School Facilities Act of 1998, California Education Code Sections 17070.10 through 17079, and that are submitted to the Division of the State Architect for plan review after July 1, 2011 in accordance with the Education Code 17075.50, shall include locks that allow doors to classrooms and any room with an occupancy of five or more persons to be locked from the inside. The locks shall conform to the specification and requirements found in Section 1010.1.9. 2019 California Building Code Section 1010.1.11

Exceptions:

1. Doors that are locked from the outside at all times such as, but not limited to, janitor's closet, electrical room, storage room, boiler room, elevator equipment room and pupil restroom.
2. Reconstruction projects that utilize original plans in accordance with California Administrative Code, Section 4-314.
3. Existing relocatable buildings that are relocated within same site in accordance with California Administrative Code, Section 4-314.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers and their abbreviations used in this schedule:

BES	Best Locking Systems
GLY	Glynn-Johnson Hardware
IVE	H. B. Ives
KEE	Keedex
KNC	K. N. Crowder
LCN	LCN Closers
SCE	Schlage Electronics
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International

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.

2.3 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.
8. Deadbolts: stainless steel 1-inch throw.
9. Electric operation: Manufacturer-installed continuous duty solenoid.
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.
11. Scheduled Lock Series and Design: Schlage L series, 06A design.
12. Certifications:

a) ANSI A156.13, 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 2019 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.

2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
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.
8. Exterior doors scheduled with XP-series devices**:** Static load force resistance of at least 2000 pounds.
9. Accessibility: Require not more than 5 lb to retract the latchbolt, per CBC 2019 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**:**

1. Non-Fire Rated Devices**:** cylinder dogging.
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.
4. Fire-Labeled Devices**:** UL label indicating “Fire Exit Hardware”. Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
5. Inpact 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

A. 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.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
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 2019 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.

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.

E. 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.

F. Thresholds**:** As scheduled and per details. Comply with CBC 2019 11B-404.2.5. Substitute products**:** certify that the products equal or exceed specified material's thickness. Proposed substitutions**:** submit for approval.
    2. Saddle thresholds**:** 0.125 inches minimum thickness.

3. 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. National Guard Products' "COMBO" or Pemko Manufacturing's "FHSL".
4. 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.
5. Fire-rated openings, 3-hour duration: Thresholds, where scheduled, to extend full jamb depth.
6. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.
7. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.
8. 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.
1. Exception: surface-mounted overhead stops, holders, and friction stays.

G. Silencers: Interior hollow metal frames, 3 for single doors, 4 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.

H. 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:

Finishes

ANSI	US	Description	Base Metal
626	US26D	Satin Chromium Plated Over Nickel	Brass, Bronze
630	US32D	Satin Stainless Steel	Stain. Steel 300 Ser
652	US26D	Satin Chromium Plated Over Nickel	Steel
689	US28	Aluminum Painted	Any
AA		Anodized Aluminum	Aluminum
GRY		Grey	Any
US32D	US32D	Satin Stainless Steel, 300 Series	Stainless Steel

D.

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.

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.
1. Locate latching hardware between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1010.1.9.2 and 11B-404.2.7.
2. Locate panic hardware between 36 inches to 44 inches above the finished floor.
3. 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.

C. Existing frames and doors to be retrofitted with new hardware:

1. Field-verify conditions and dimensions prior to ordering hardware. Fill existing hardware cut outs not being reused by the new hardware. Remove existing hardware not being reused, return to Owner unless directed otherwise.
2. Remove existing floor closers not scheduled for reuse, fill cavities with non-shrinking concrete and finish smooth.
3. Cut and weld existing steel frames currently prepared with 2.25 inch height strikes. Cut an approximate 8 inch section from the strike jamb and weld in a reinforced section to accommodate specified hardware's strike.

4. Patch and weld flush filler pieces into existing door hardware preparations in steel doors and frames, leave surfaces smooth.
5. Glue in solid wood block fillers to fill cut outs in existing wood doors, sand surfaces smooth. Alternatively, use an approved epoxy-based wood filler product, submit product data for approval.

3.3 INSTALLATION

A. Install hardware per manufacturer's instructions and recommendations. 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 that 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should 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.

G. Field-verify existing conditions and measurements prior to ordering hardware. Fill existing hardware cut outs not being used by the new hardware.

H. Remove existing hardware not being reused. Tag and bag removed hardware, turn over to Owner.

I. Where existing wall conditions will not allow door to swing using the scheduled hinges, provide wide-throw hinges and if needed, extended arms on closers.

J. Provide manufacturer's recommended brackets to accommodate the mounting of closers on doors with flush transoms.

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 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.

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.
4. Has submitted written report identifying problems.

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.

HARDWARE GROUP NO. 01
For use on Door #(s):
401A 411A 412A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	CORE (COMBINATED)	1C72 18A J KEYWAY		626	BES
1	EA	EU MORTISE LOCK	L9092BDEU 06A RX CON 12/24 VDC	✓	626	SCH
1	EA	CONSTRUCTION CORE	1C7-GREEN		626	BES
1	EA	SURFACE CLOSER	4040XP HCUSH		689	LCN
1	EA	FLOOR STOP	FS18S		BLK	IVE
1			CARD READER - WORK OF DIVISION 28			
1	EA	POWER SUPPLY	POWER SUPPLY BY DIVISION 28			BYO

PERIMETER SEALS BY DOOR/FRAME MANUFACTURER
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):
402A 403A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	CORE (COMBINATED)	1C72 18A J KEYWAY		626	BES
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL	✓	626	VON
1	EA	SFIC RIM CYLINDER	80-116		626	SCH
1	EA	CONSTRUCTION CORE	1C7-GREEN		626	BES
1	EA	SURFACE CLOSER	4040XP HCUSH		689	LCN
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED			
1	EA	POWER SUPPLY	PS902 120/240 VAC	✓	LGR	SCE
1			CARD READER - WORK OF DIVISION 28			
1	EA	POWER SUPPLY	POWER SUPPLY BY DIVISION 28			BYO

PERIMETER SEALS BY DOOR/FRAME MANUFACTURER
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
For use on Door #(s):
408A 410A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	↯	630	IVE
1	EA	CORE (COMBINATED)	1C72 18A J KEYWAY		626	BES
1	EA	EU MORTISE LOCK	L9092BDEU 06A RX CON 12/24 VDC	↯	626	SCH
1	EA	CONSTRUCTION CORE	1C7-GREEN		626	BES
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	SET	GASKETING	328AA-S		AA	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	MOUNTING BRACKET	328SPB			ZER
1			CARD READER - WORK OF DIVISION 28			
1	EA	POWER SUPPLY	POWER SUPPLY BY DIVISION 28			BYO

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
For use on Door #(s):
406A 407A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	↯	630	IVE
1	EA	CORE (COMBINATED)	1C72 18A J KEYWAY		626	BES
1	EA	EU MORTISE LOCK	L9092BDEU 06A RX CON 12/24 VDC	↯	626	SCH
1	EA	CONSTRUCTION CORE	1C7-GREEN		626	BES
1	EA	SURFACE CLOSER	4040XP HCUSH		689	LCN
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	SET	GASKETING	328AA-S		AA	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	MOUNTING BRACKET	328SPB			ZER
1			CARD READER - WORK OF DIVISION 28			
1	EA	POWER SUPPLY	POWER SUPPLY BY DIVISION 28			BYO

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. 05
For use on Door #(s):
404A 404B 405A 405B 409A 409B
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	↯	630	IVE
1	EA	CORE (COMBINATED)	1C72 18A J KEYWAY		626	BES
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL	↯	626	VON
1	EA	SFIC RIM CYLINDER	80-116		626	SCH
1	EA	CONSTRUCTION CORE	1C7-GREEN		626	BES
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	SET	GASKETING	328AA-S		AA	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	MOUNTING BRACKET	328SPB			ZER
1	EA	POWER SUPPLY	PS902 120/240 VAC	↯	LGR	SCE
1			CARD READER - WORK OF DIVISION 28			

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
For use on Door #(s):
408B
Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CORE (COMBINATED)	1C72 18A J KEYWAY	626	BES
1	EA	CONSTRUCTION CORE	1C7-GREEN	626	BES

BALANCE OF HARDWARE BY DOOR MANUFACTURER

MAINTENANCE MATERIALS: Provide the following as per Sections 01 77 00 and 01 78 23.

- As-built hardware schedule
- Copies of warranty information for each hardware type
    - Include a requirement for factory order numbers, needed by Owner if claim needs to be made.
- Binder of catalog cuts or complete catalog sections of items used, installation and maintenance/adjustment information.
- Collection of tools that were included with the hardware: wrenches, drivers, etc.

END OF SECTION



224HD Full Mortise - Door Edge Protector

UL10C certified

Meets ANSI 156.26 for 150 lbs

- For 1 3/4" Doors
- Door Edge Protector
- Spread bearing design
- Non Handed for custom cut lengths
- 1/16" Door Inset
- 48" Maximum Door Width
- Beveled or Square Edge Doors
- For doors weighing up to 450 pounds without reinforcing, 600 pounds with reinforcing

Standard lengths 83", 85", 95", 120"

Standard Mounting Hardware

12-24 x 3/4" Steel Self Drilling / Self Tapping Phillips Head Screw

Finishes

Clear Anodized (US28), Dark Bronze Anodized (313AN)

Custom Anodizing and Painting are available, consult factory

Options:

HT	Hospital Tip
EPT	Electric Power Transfer
TWPCON*	Through Wire Panel with Allegion Connect
TWP*	Electrical Through Wire Panel
TW8	Electrical Through Wire

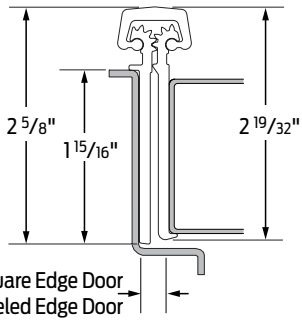
*TWP only available on lengths <= 95"

Optional Mounting Hardware:

SEC/HM	Security Screws - Hollow Metal Door and Frame
SEC/WD/HM	Security Screws - 1/2 Wood, 1/2 Hollow Metal
TF	Thread Forming Screws
TEK/WD	1/2 Self Drill, Self Tap / 1/2 Wood
WD	Wood Door and Frame

For Single Door Applications

For pairs of doors see chart and general information



5/16" Clearance for Square Edge Door
11/32" Clearance for Beveled Edge Door

General Information - Electrification Options

ELECTRIC POWER TRANSFER (EPT) AVAILABILE ON HD AND XY MODELS

Electric power transfer provides the most secure and best solution for transferring power from the door frame to the edge of a swinging door. Ives Continuous Hinges provide standard cut outs to fit Von Duprin EPT-2, EPT-10 and PNT-1 devices. Consult factory for other electrical cut out options. Door handing is required.

ELECTRICAL THROUGH-WIRE PANEL (TWP) FOR HD MODELS

The HD continuous hinge with Through-Wire Panel features a three piece hinge design. It includes top and bottom main hinges sections and a 4 1/2" tall through-wire panel. The panel can be removed for service and replaced as needed. Provides electric power transfer from the frame to the door via a ribbon cable in order to supply power to an electrified mortise or cylidrical locks, exit devices with electric latch retraction, and/or electric strikes (pairs of doors). Through-wire is rated 50 volts AC/DC at 3.5 amp continuous and 16 amp pulse. Maximum pulse 400 milliseconds. Ives through-wire hinges are fully compatible with 4 wire and 8 wire installations. Recommended for low frequency usage. Warrantied up to 250,000 cycles

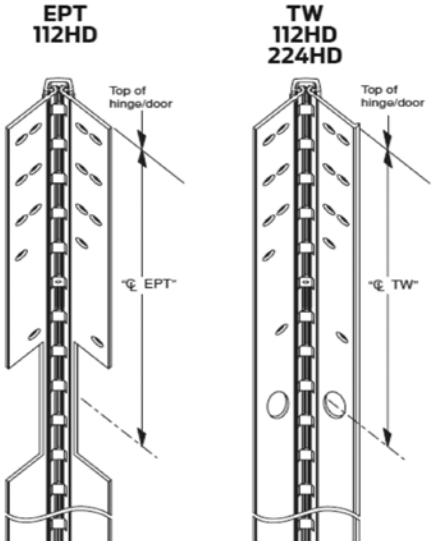
ELECTRICAL THROUGH-WIRE (TW8) FOR HD MODELS ONLY

Recommended for low frequency usage. Provides electric power transfer from the frame to the door via a ribbon cable in order to supply power to an electrified mortise or cylidrical locks, exit devices with electric latch retraction, and/or electric strikes (pairs of doors). Through-wire is rated 50 volts AC/DC at 3.5 amp continuous and 16 amp pulse. Maximum pulse 400 milliseconds. Ives through-wire hinges are fully compatible with 4 wire and 8 wire installations. Requires the door to be torn down for maintenance. Warrantied up to 250,000 cycles.

NEW ELECTRICAL THROUGH-WIRE PANEL WITH ALLEGION CONNECT (TWP CON) (XY MODELS ONLY)

The most secure and best solution for powering your door. The redesigned XY Through-Wire Panel is heavy duty and easy-to-install. Hinge consists of single piece cover design for improved aesthetics and three sections with a standard bottom length and through wire panel location. The panel can quickly slip in and out of the the hinge for maintenance and replacement. Unlike all of the other manufacturer solutions, the XY through-wire panel maintains a one piece appearance on the cover side of the hinge. The new wire design features a teflon coated wire which greatly improves performance and durability. The new panel also comes standard with the Allegion Connect 8-pin Connector which makes it easy to connect to other electrical consumption devices. Warrantied for up to 5 years. Door handing is required.

Provides electric power transfer from the frame to the door in order to supply power to an electrified mortise or cylidrical locks, exit devices with electric latch retraction, and/or electric strikes (pairs of doors). Through-wire is rated 50 volts AC/DC at 3.5 amp continuous and 16 amp pulse. Maximum pulse 400 milliseconds. Ives through-wire hinges are fully compatible with 4 wire and 8 wire installations.



ELECTRICAL CUTOUTS

Ives Aluminum Continuous Hinges are available with factory modified cutouts to accommodate most electrical frame to door requirements. Special templates are required.

WHEN ORDERING INDICATE THE FOLLOWING:

1. Opening size.

2. Handing. LH, RH, LHR or RHR.

3. Manufacturer and model number of the electrical product being used. Example; Von Duprin ETPT2

Because clearances may vary between door and frame manufacturer, and locations can be influenced by the door hardware it is always recommend contacting Ives Customer Technical for specific template information.

Below are standard locations for Von Duprin EPT2 or EPT10, and monitor switch.

In accordance with industry standards, all cutouts are made from Top Edge of Door to Center Line of Cut-Out

Note: See ordering guide in price book for proper placement.

Standard Length	HD	HD	HD	XY	XY
	EPT	TW8	TWP	EPT	TWP CON
83"	30"	41-1/2"	41-1/2"	30"	43.5"
85"	32"	42-1/2"	42-1/2"	32"	45.5"
95"	42"	57-3/4"	57-3/4"	42"	55.5"
119" (XY)	–	–		66"	79.5"
120" (HD)	67"	81-25/32"	81-25/32"	–	–

HD TWP Option centered in hinge. XY TWP CON is located 39.5 inches from bottom of the hinge. Consult factory for TWP locations on custom length hinges.



Meets ANSI/BHMA A156.1
A8133 – Steel
A5133 – Stainless Steel
A2133 – Brass

5PB1 5 Knuckle, Plain Bearing Full Mortise Hinge

- For standard weight doors
- Low frequency usage
- Packed with wood and metal screws

Not for use with a door closer.

Options

- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

Size (Inches)	Size (mm)	Gauge
3.5 x 3.5	89 x 89	0.123
4 x 4	102 x 102	0.134
4.5 x 4	114 x 102	0.134
4.5 x 4.5	114 x 114	0.134
5 x 4.5	127 x 114	0.134



Meets ANSI/BHMA A156.1
A8112 – Steel
A5112 – Stainless Steel
A2112 – Brass

5BB1 5 Knuckle, Ball Bearing Full Mortise Hinge

- For standard weight doors
- Medium frequency usage
- 2 ball bearing
- Packed with wood and metal screws

Options

- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

Size (Inches)	Size (mm)	Gauge	Size (Inches)	Size (mm)	Gauge
3.5 x 3.5	80 x 102	0.130	5 x 4.5	127 x 114	0.146
4 x 4	102 x 102	0.130	5 x 5	127 x 127	0.146
4.5 x 4	114 x 102	0.134			
4.5 x 4.5	114 x 114	0.134			

Finishes *brass*

Ives Finish	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	605	606	612	613	614	616	619	625	626

Finishes *steel*

Ives Finish	USP	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	600	632	633	639	640	641	643	646	651	652

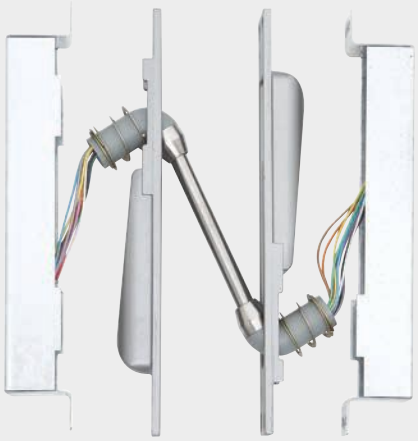
Finishes *stainless steel*

Ives Finish	US32	US32D
BHMA	629	630

ALLEGION™

VON DUPRIN®

Electrical power transfer



Overview

Electric power transfer provides a means of transferring electrical power from a door frame to the edge of a swinging door. The units are completely concealed when the door is in the closed position, and are ideally suited for installations involving abuse or heavy traffic.

Two models are available; EPT-2, two 18 gauge wires and EPT-10, ten 24 gauge wires.

Features and benefits

- UL Listed for use on fire doors
- UL listed as Miscellaneous Door Accessory
- Ball-and-socket joint construction provides cut and pinch protection for wiring
- Built for heavy traffic and high abuse openings

Door applications

- Up to 5" butt hinges – 180° swing.
- 5 1/2" butt hinges – 130° swing.
- 6" butt hinges – 110° swing.
- 3/4" offset pivots – 180° swing.

Not for use with swing clear hinges, center-hung pivots, pocket pivots or balanced doors.

Door applications shown are for 1 3/4" door thickness, for all other applications contact Technical Support to confirm compatibility.

Finishes

- SP28 (sprayed aluminum)
- SP313 (sprayed duranodic)

Dimensions

Housing	9" X 1 1/4 X 1 5/8 (229mm X 32mm X 38mm)
EPT-2	Two 18 gauge wires, up to 2 AMPS @ 24VDC, with a 16 AMPS maximum surge
EPT-10	Ten 24 gauge wires, up to 1 AMPS @ 24VDC, with a 16 AMPS maximum surge
PNT-1	5/32" tubing

To order, specify

- **EPT-2, EPT-10 or PNT-1.**
- **Finish, SP28 or SP313.**

About Allegion

Allegion (NYSE: ALLE) is a global pioneer in safety and security, with leading brands like CISA®, Interflex®, LCN®, Schlage® and Von Duprin®. Focusing on security around the door and adjacent areas, Allegion produces a range of solutions for homes, businesses, schools and other institutions. Allegion is a $2 billion company, with products sold in almost 130 countries. For more, visit **www.allegion.com.**

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SCHLAGE

L909x Series

Electrified mortise lock



Overview

The most complex electronic access systems still rely on mechanical hardware to operate properly. Advanced electronic technology can go to waste without adequate mechanical locking strength and functionality.

The Schlage L909x series of electrified mortise locks serves as the mechanical component to an electrified locking solution. The lock can be integrated into an electronic access control system or be used as a stand-alone solution with a buzzer or other device as the controller.

The L909x series offers exceptional flexibility and power savings. The lock automatically adapts to 12 or 24V DC input, and a case-mounted switch allows selection between EL and EU operation. Request to exit is modular and can be added without opening the lock case. 0.4amps maximum current draw allows multiple units on a single power supply, while 0.01amps holding current eliminates “hot levers” in EL applications.

Utilizing the same levers, trims and options as the Schlage L-series mortise, the L909x integrates as seemless with the mechanical component of the project as the electronic. And because it is based on the Schlage L mortise, it carries the same proven record of performance, strength and durability from the most trusted name in the industry.

Recommended applications

The L909x Series Electrified Mortise Lock is useful for many applications, including but not limited to:

- Security control centers
- Cashier rooms
- Fire safety exits
- Equipment rooms
- Hazardous material storage

Features and benefits

- Universal input voltage- accepts 12 or 24V DC for installation flexibility
- User selectable fail safe/fail secure through use of switch on lock case
- Low maximum current draw allows multiple locks on a single power supply
- Low holding current produces minimal heat, eliminating “hot levers” in electrically locking applications
- Modular RX design allows RX to be added at a later time without opening the lock case
- UL listed for 3 hour fire door

Available Options:

- Request to Exit (RX)
- Latchbolt Monitor (LX)
- Door Position Sensor (DPS)
  - non-deadbolt functions only
- Deadbolt Monitor (DM)
  - deadbolt functions only

L Series mechanical specifications

Handing	Field reversible
Door thickness	1 3/4" (44 mm) standard, 1 3/8" (35 mm) to 2 1/2" (64 mm) optional. Over 2 1/2" (64 mm) door ranges vary by function. Specify door thickness other than 1 3/4".
Backset	2 3/4" (70 mm) only
Armored front	Standard: 1 1/4" x 8" x 7/32" (32 mm x 203 mm x 6 mm) Optional: 1 1/16" x 8" x 7/32" (27 mm x 203 mm x 6 mm)
Case size	4 7/16" x 6 1/16" x 1" (113 mm x 154 mm x 25 mm)
Spacing	Knob or lever to cylinder, 3 7/8" (98 mm); knob or lever to thumbturn hub, 2 11/16" (68 mm)
Bolts	1" (25 mm) throw stainless steel deadbolt and 3/4" (19 mm) throw stainless steel latch with anti-friction tongue
Cylinders and keys	6-pin solid brass cylinder is standard with Everest 29 S123 keyway furnished as default. Furnished with 2 nickel silver keys. Additional Schlage keyways available.
Keying options	Available in full size interchangable core (FSIC) and small format interchangable core (SFIC). Also available less cylinder and less FSIC to allow for Primus XP cylinder usage.
Strike	ANSI curved lip strike 1 1/4" x 4 7/8" (32 mm x 124 mm) x 1 3/16" (30 mm) lip to center with dust box standard
Trim	Three rose (sectional) trims and two escutcheon trims
Levers	30 available lever designs

L Series electronic specifications

Voltage	Auto-detects 12/24V DC operation
Peak current	0.4 amps
Holding current	0.010 amps
Operating temperature	Maximum +140°F (+60°C) Minimum -22°F (-30°C)
Interfacing devices	HandReaders, wall switches, security consoles, access card readers, thermo-sensitive devices, smoke and fire alarms, telephone access controls, automatic time devices and computerized controls
Micro switch electrical rating for request-to-exit (RX) function and latchbolt monitor (LX)	3 amps, 125V AC; 2 amps, 30V DC

L Series electrified functions

No Cylinder	L9090EL/EU Electrically locking/unlocking outside lever L9091EL/EU Electrically locking/unlocking both levers
Outside Cylinder	L9092EL/EU (Replaces L9080EL/EU) Electrically locking/unlocking outside lever L9093EL/EU Electrically locking/unlocking both levers
Inside & Outside Cylinder	L9094EL/EU Electrically locking/unlocking outside lever L9095EL/EU (Replaces L9082EL/EU) Electrically locking/unlocking both levers

Note: See pricebook for additional details.

L Series electrified deadbolt functions

Outside Cylinder	L9492EL/EU Electrically locking/unlocking outsider lever L9493EL/EU Electrically locking/unlocking both levers
Inside & Outside Cylinder	L9494EL/EU Electrically locking/unlocking outsider lever L9495EL/EU Electrically locking/unlocking both levers

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About Allegion

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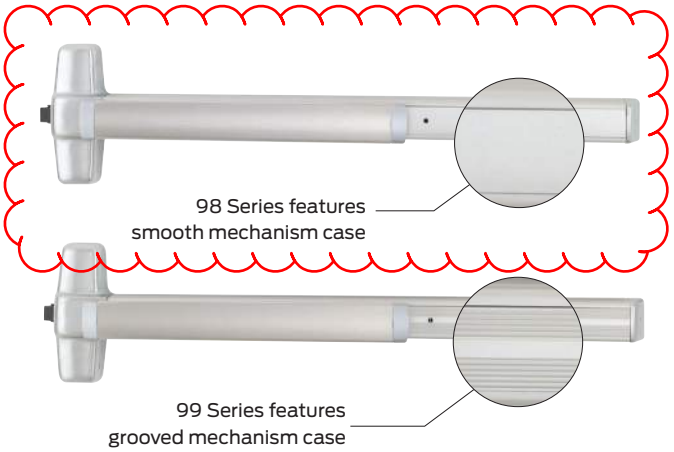
VON DUPRIN®

Exit device

98/99 Series

Overview

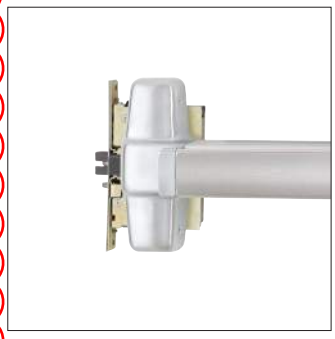
The 98/99 Series devices are heavy-duty push pads. The 98 Series has a smooth mechanism case, while the 99 Series has a grooved mechanism case. The 98/99 Series has been certified to the highest industry standards and are used in schools, hospitals and government buildings.



Device types



Rim device



75 Mortise lock device



27 Surface mounted vertical rod device [1]



47 Concealed vertical rod device, 5/16" throw [1]

48 Concealed vertical rod device, 5/8" top, 1 1/2" bottom throw



47WDC Concealed vertical rod wood door device [1]



49 Concealed vertical cable device [2]



50WDC Concealed vertical cable wood door device



57 Three-point latch device

[1] Also available less bottom rod (LBR)
[2] Also available less bottom latch (LBL)

ALLEGION™

VON DUPRIN®

Exit device

98/99 Series

Finishes



605
Bright Brass



606
Satin Brass



612
Satin Bronze



619
Satin Nickel



622
Matte Black

625
Bright Chrome



626
Satin Chrome



626AM
Satin Chrome, Antimicrobial



628
Aluminum, Clear Anodized



630
Satin Stainless



630AM
Satin Stainless, Antimicrobial



643e
Aged Bronze



693
Black



710
Dark Brown, Anodized

Due to the many variations in monitors and printers, color samples may appear different than the physical product. Contact your local sales representative for a physical color sample.

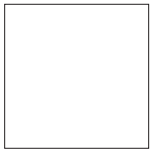
ALLEGION™

VON DUPRIN®

Exit device

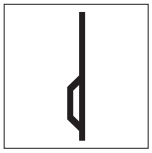
98/99 Series

Trim functions



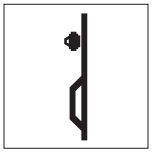
EO No outside trim

- Exit only



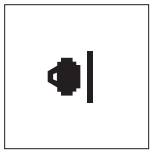
DT Dummy trim

- Pull when dogged (not recommended for fire device)



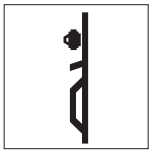
NL Night latch

- Key retracts latchbolt
- Rim and 1 ¼" mortise cylinder



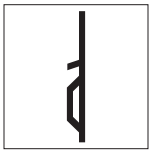
NLOP Night latch

- Key retracts latchbolt, pull required



TP Thumbpiece

- Key locks and unlocks
- Rim and 1 ¼" mortise cylinder



TPBE Thumbpiece, blank escutcheon

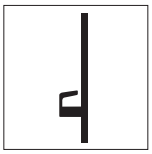
- Blank escutcheon always operable (no cylinder, use with DT trim)



L Lever

K Knob

- Key locks and unlocks
- Rim and 1 ¼" mortise cylinder
- Handed, reversible lever
- Electrified lever operation available



LDT Lever, dummy trim

KDT Knob, dummy trim

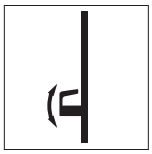
- Pull when dogged



LNL Lever, night latch

KNL Knob, night latch

- Key retracts latchbolt
- Rim and 1 ¼" mortise cylinder
- Handed, reversible lever



LBE[1] Lever, blank escutcheon

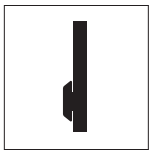
KBE Knob, blank escutcheon

- Always operable (no cylinder)



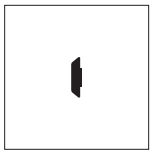
TL Turn lever

- Key locks and unlocks (use with DT trim)
- 1 ¼" mortise cylinder



TLBE Turn lever, blank escutcheon

- Blank escutcheon always operable (no cylinder, use with DT trim)



TLOP Turn lever, optional pull



HL Hospital latch

- Key locks and unlocks
- 1 ¼" mortise cylinder

ALLEGION™

VON DUPRIN®

Exit device

98/99 Series

Trim styles



990



996



696



697
3/4" (19mm) diameter pull



392-7



HL



374



VR910



VR914

Dimensions

Trim style	Width	Height	Thickness	Projection
990	3"	14 3/16"	3/32"	2"
996 Knob	2 3/4"	10 3/4"	27/32"	3 1/4"
996 Lever	2 3/4"	10 3/4"	27/32"	2 7/8"
696	1 5/8"	13 1/2"	3/16"	2 1/6"
697	1 5/8"	13 1/2"	3/16"	3"
392-7	3/4" inch round stainless steel with 7" center to center that matches the 98/99 center case. 3 1/2" offset with 1 1/2" clearance.			
HL	2 9/16"	7 7/8"	-	2 5/8"
374	2 3/4"	10 3/4"	27/32"	
VR910/914 with RIM/verticals	5 1/2"	11"	-	
VR910/914 with mortise	7 1/4"	11"	-	

ALLEGION™

VON DUPRIN®

Exit device

98/99 Series

Lever styles

Decorative levers



M51
- Knurling available



M52
- Knurling available



M53



M54



M55



M56



M57[1]



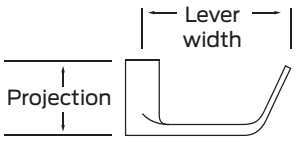
M61
- Handed



M62[1]
- Handed

Dimensions

Lever	Width	Projection
M51	4.5"	2.5"
M52	4.5"	2.4"
M53	4.4"	2.4"
M54	4.4"	2.3"
M55	4.4"	2.7"
M56	4.5"	2.3"
M57	4.5"	2.7"
M61	4.5"	2.7"
M62	4.6"	2.4"



[1] Available in stainless steel substrate only

VON DUPRIN®

Exit device

98/99 Series

Lever styles

Decorative levers



M63
- Handed



M81
- Knurling available



M82



M83



M84



M85
- Handed



ME1[1]
- Handed



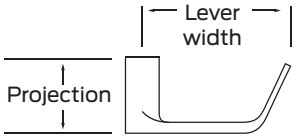
ME2[1]
- Handed



ME3[1]

Dimensions

Lever	Width	Projection
M63	4.6"	2.6"
M81	4.8"	2.5"
M82	4.9"	2.5"
M83	4.7"	2.25"
M84	5.1"	2.2"
M85	4.9"	2.7"
ME1	5.4"	2.6"
ME2	5.2"	2.4"
ME3	5"	2.8"



[1] Designed with Gensler as product design consultant

ALLEGION™

VON DUPRIN®

Lever styles

Standard levers



01



02
- Knurling available



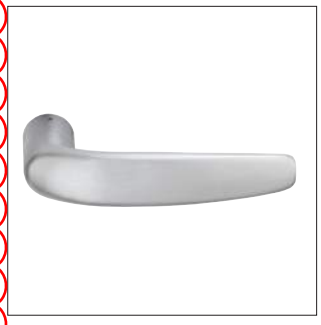
03
- Knurling available



05



06
- Default lever
- Suites with Schlage Rhodes
- Knurling available



07
- Suites with Schlage Athens



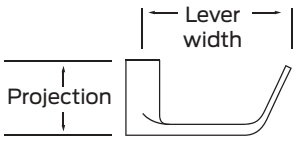
12
- Handed



16
- Suites with Schlage Omega

Dimensions

Lever	Width	Projection
01	4.0"	2.1"
02	4.75"	2.3"
03	4.75"	2.813"
05	3.75"	2.8"
06	4.7"	2.1"
07	4.6"	2.3"
12	4.3"	2.9"
16	5.05"	2.66"



ALLEGION™

VON DUPRIN®

Exit device

98/99 Series

Lever styles

Standard levers



17
- Suites with Schlage Sparta
- Knurling available



18



Accent (ACC)
- Handed



Asti (AST)
- Handed



Merano (MER)
- Handed



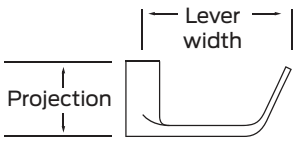
Latitude (LAT)



Longitude (LON)

Dimensions

Lever	Width	Projection
17	4.7"	2.3"
18	4.75"	2.4"
Accent (ACC)	4.4"	3.1"
Asti (AST)	4.2"	2.5"
Merano (MER)	4.1"	2.5"
Latitude (LAT)	4.6"	2.3"
Longitude (LON)	4.9"	2.3"



ALLEGION™

VON DUPRIN®

Exit device

98/99 Series

Electromechanical device options

Switches

LX **Latchbolt monitoring**

LX-LC **Latchbolt monitoring, low current**
- Signals use of an opening
- SPDT switch to monitor latch bolt
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

RX **Request to exit**

RXLC **Request to exit - low current**

RX2 **Double request to exit - 2 RX switches**

WP-RX **Waterproof request to exit**

RX-AUX **RX to RX-2 conversion**
- Signals use of an opening
- SPDT switch to monitor pushpad
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

LX-RX **Request to exit/latchbolt monitoring combination**

LX-RX-LC **Request to exit/latchbolt monitoring combination, low current**
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

SS **Signal switch**
- Monitors pushpad and latchbolt
- Signals unauthorized use of an opening
- Switch makes latch bolt tamper-resistant
- Up to 2.0 A @ 24VDC

Latch retraction

EL **Electric latch retraction**

SD-EL **Electric latch retraction with special center case dogging**
- Enables remote unlatching
- Alternative to manual dogging
- Voltage: 24VDC (continuous duty)
- Current: 16.0 A inrush / 0.3 A holding

QEL **Quiet electric latch retraction**

HD-QEL **Quiet electric latch retraction with hex dogging**

SD-QEL **Quiet electric latch retraction with special center case dogging**
- Bolt retraction via switch
- Converts exit door to push-pull operation
- Voltage: 24VDC
- Current: 1.0 A inrush (0.5 sec.) / 0.14 A holding

Delayed egress

CX **Chexit delayed exit**
- Meets NFPA 101 requirements
- Self-contained controls, locking, alarm
- Input voltage: 24VDC
- Input current inrush: 1.25 A
- Input current holding: 390 mA
- Alarm relay and secure relay contact ratings: 24 VDC, 1 A

CX-RCM **Chexit remote module**
- Chexit for smaller doors that can not accommodate a standard Chexit device
- Size: 3.75” x 5.57” x 2.50”
- Input voltage: 24VDC
- Input current inrush: 1.25A
- Input current holding: 390mA
- Alarm relay and secure relay contact ratings: 24 VDC, 1 A

Miscellaneous

ALK **Alarm exit kit**
- Unauthorized opening triggers 85-decibel horn
- Set in armed or disarmed mode by key
- Assembly includes both a 24VDC input and external inhibit

VON DUPRIN®

Electromechanical device options

CON **Allegion Connect**

- Common connectors to connect various door hardware all the way to the power supply

E996 **Electric locking and unlocking trim**

- Remains latched while unlocked
- Remote electrical control
- Voltage: 24VDC (Continuous Duty)
- Current: 0.22 amps

E7500 **Electric mortise lock device**

- Voltage: 12 or 24VDC
- Current: 0.60 amps @ 12VDC, 0.30 amps @ 24VDC

VON DUPRIN®

Exit device

98/99 Series

Electromechanical device options

Matrix shows available options per device type but does not represent compatibly across multiple options.

	Switches									Latch retraction					Delayed egress		Misc			
	LX	LX-LC	RX	RXLC	RX2	WP-RX	LX-RX	LX-RX-LC	SS	EL	SD-EL	QEL	HD-QEL	SD-QEL	CX	CX-RCM	ALK	CON	E996	Mortise
98 99	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
98F 99F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
XP98 XP99		■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	
XP98-F XP99-F		■	■	■	■	■	■	■		■		■			■	■	■	■	■	
9875 9975			■	■	■	■			■	■	■	■	■	■	■	■	■	■	■	■
9875-F 9975-F			■	■	■	■			■	■		■			■	■	■	■	■	■
9827 9927	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9827-F 9927-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9857 9957	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9857-F 9957-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9847 9947	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9847-F 9947-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9848 9948	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9848-F 9948-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9849 9949	■[1]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9849-F 9949-F	■[1]	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9847WDC 9947WDC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9847WDC-F 9947WDC-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9850WDC 9950WDC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9850WDC-F 9950WDC-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	

[1] For 98/9949 devices, LX switch monitors trim input or electric dogging of EL/QEL devices. LX switch does not monitor latchbolt condition.

ALLEGION™

VON DUPRIN®

Exit device

98/99 Series

Mechanical device options

Dogging

CD — **Cylinder dogging, panic only**

CD-CX — **Center case cylinder dogging for Chexit devices**

CI — **Cylinder dogging indicator**
- Battery-operated dogging indicator in cylinder format with red light visible from over 75 feet away

DI — **Dogging indicator**
- Battery-operated dogging indicator in hex format with red light visible from over 75 feet away

LD — **Less dogging**

SD — **Special center case dogging**
- Center case cylinder dogging

Classroom security

-2 — **Double cylinder**
- Inside key cylinder locks/unlocks outside trim

-2SI — **Double cylinder with security indicator**
- Inside key cylinder locks/unlocks outside trim with visible indicators that provide status of door

CDSI — **Cylinder dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged

HDSI — **Hex dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged

Environmental

PN — **Pneumatic latch retraction**
- For areas where electrical devices banned
- Special linkage for mechanical or pneumatic dogging

QM — **Quiet mechanical option**
- Provides damper-controlled relatching of device

INS — **Insulclad kits**
- Kits with longer fasteners or parts for Insulclad doors

AM — **Anti-microbial finish**

Weatherized

WH — **Weep holes**
- Drainage (weep) holes in mechanism case

WS — **Windstorm**
- Severe weather certified/tested
- FEMA and ICC compliant
- Tornado and hurricane tested

California code

AX — **Accessible device**
- UL certified to meet new 5 lb. maximum operating force requirement
- Exceeds ANSI/BHMA requirements

Latches

PL — **Pullman latch**
- Latches are always extended
- Most commonly used in conjunction with electric strikes and LBR-less bottom rod application

VON DUPRIN®

Mechanical device options

Touch bar trim

RSS **Red silk screen**
- Red silk-screened lettered touchbar trim

PUSH **PUSH**
- Touchbar trim embossed PUSH

SG **Safety glow**
- Self-illuminating touchpad
- Glows brightly during low or no light conditions

KN **Knurled touchbar**
- Tactile warning applied to device

BRAILLE **Braille**
- Vision impaired touchpad
- Raised letter and Braille

VON DUPRIN®

Exit device

98/99 Series

Mechanical device options

Matrix shows available options per device type but does not represent compatibly across multiple options.

	Dogging						Classroom security				Environmental				Weatherized		CA code
	CD	CD-CX	CI	DI	LD	SD	-2	-2SI	CDSI	HDSI	PN	QM	INS	AM	WH	WS	AX
98 99	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■
98F 99F							■	■			■	■		■	■		■
XP98 XP99	■	■	■	■	■	■	■	■	■	■				■	■		■
XP98-F XP99-F							■	■						■	■		■
9875 9975	■	■	■	■	■	■	■		■	■	■			■	■		
9875-F 9975-F							■				■			■	■		
9827 9927	■	■	■	■	■	■			■	■	■	■		■	■	■	■ LBR
9827-F 9927-F											■	■		■	■	■	■ LBR
9857 9957	■	■	■	■	■	■			■	■	■			■	■	■	
9857-F 9957-F											■			■	■	■	
9847 9947	■	■	■	■	■	■			■	■	■		■	■	■		■ LBR
9847-F 9947-F											■			■	■		■ LBR
9848 9948	■	■	■	■	■	■			■	■	■			■	■		
9848-F 9948-F											■			■	■		
9849 9949	■	■	■	■	■	■			■	■	■		■	■	■		■ LBL
9849-F 9949-F											■			■	■		■ LBL
9847WDC 9947WDC	■	■	■	■	■	■			■	■	■			■	■		
9847WDC-F 9947WDC-F											■			■	■		
9850WDC 9950WDC	■	■	■	■	■	■			■	■	■			■	■		■ LBL
9850WDC-F 9950WDC-F											■			■	■		■ LBL

VON DUPRIN®

Mechanical device options

Matrix shows available options per device type but does not represent compatibly across multiple options.

	Latches	Touch bar trim				
	PL	RSS	PUSH	SG	KN	BRAILLE
98 99		■	■	■	■	■
98F 99F		■	■	■	■	■
XP98 XP99		■	■	■	■	■
XP98-F XP99-F		■	■	■	■	■
9875 9975		■	■	■	■	■
9875-F 9975-F		■	■	■	■	■
9827 9927	■	■	■	■	■	■
9827-F 9927-F		■	■	■	■	■
9857 9957		■	■	■	■	■
9857-F 9957-F		■	■	■	■	■
9847 9947	■	■	■	■	■	■
9847-F 9947-F		■	■	■	■	■
9848 9948		■	■	■	■	■
9848-F 9948-F		■	■	■	■	■
9849 9949		■	■	■	■	■
9849-F 9949-F		■	■	■	■	■
9847WDC 9947WDC		■	■	■	■	■
9847WDC-F 9947WDC-F		■	■	■	■	■
9850WDC 9950WDC		■	■	■	■	■
9850WDC-F 9950WDC-F		■	■	■	■	■

VON DUPRIN®

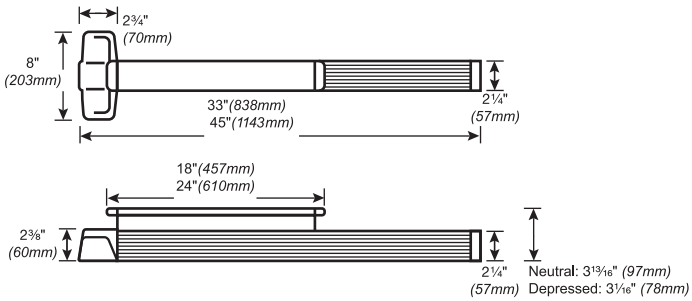
Exit device

98/99 Series

Specifications

Accessibility	▪ Force to depress push pad – AX device: 5 lbs – Standard device: 15 lbs ▪ Push pad projection – Neutral: 3 13/16" (97 mm) – Depressed: 3 1/16" (78 mm)
Certifications/ approvals	All Von Duprin 98/99 exit devices are ANSI/BHMA Certified. Please refer to the BHMA Certified Products Directory for specific listings.
Mounting height	39 13/16" (1011 mm) 39 11/16" (1008 mm) with mullion
Warranty	36 months from the date of placing the product in operation

Dimensions



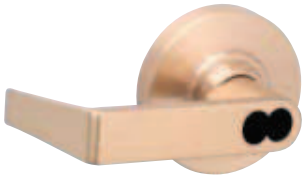
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ALLEGION™

Small Format (Best Style) Interchangeable Core Availability



AL-Series
Saturn design



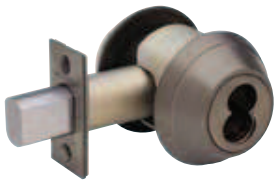
ND-Series lever
all designs



B500-Series



L400-Series



B600 / 700-Series



L9000-Series
all designs



KC 11-Series,
KC 21-Series,
KC 41-Series
padlocks



KC215-Series



KC 72-Series,
KC 82-Series,
KC 92-Series
padlocks

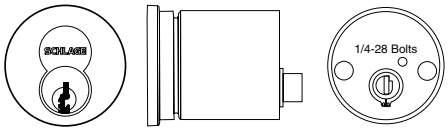
Small Format Interchangeable Core Cylinders for Schlage Locksets



Small Format Core Only

Number	Mechanism
80-036	7-pin Everest B Family restricted keyway core uncombinated
80-037	7-pin Everest B Family restricted keyway core combinated
80-043	6-pin Best keyway core, uncombinated
80-033	7-pin Best keyway core, uncombinated

Notes 1. Available 606 and 626 finish only.
2. Suffix keyway, e.g. 80-036 B235, 80-043 AB, etc.
3. Proper authorization required for Everest cores. Order control keys separately.
4. 80-043 and 80-033 available in Best A, D, E, F, G, H, J, K, L and M keyways. Suffix "B" to keyway letter, e.g. AB, DB, etc.

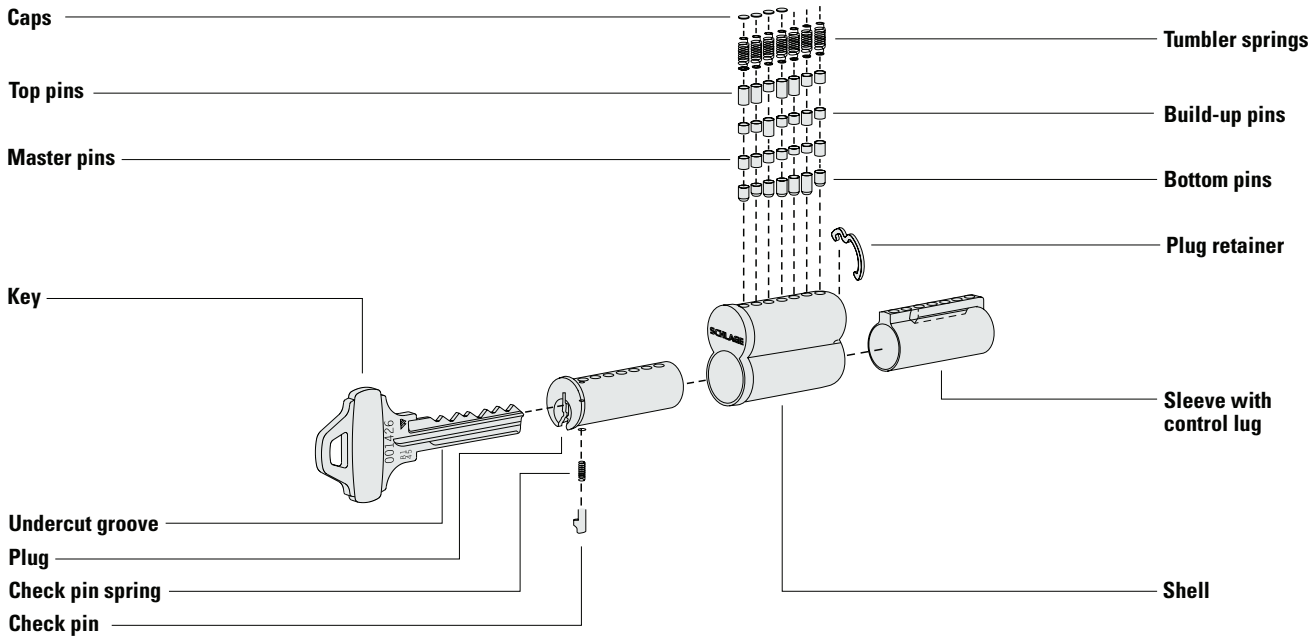


Small Format IC Housings for Commercial Deadlocks, Less Core

Lockset Series	Description	Number	Specify Finish
B500-Series	Outside	B610-204	605, 609, 612, 613, 619, 625, 626, and 716
	Inside	B610-281**	605, 609, 612, 613, 619, 625, 626, and 716
B600-Series	Outside	B610-282	605, 606, 609, 612, 613, 625, 626
	Inside	B610-281	See Note Below

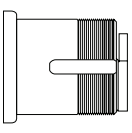
Note: To order Primus XP add the suffix - XP to the Primus part number. (Example: 12-345-XP)

Tailpieces not included.
Specify finish of B610-014 snap-on faceplate ordered separately for inside of BC162 and B662.
**Inside housing does not include snap-on faceplate

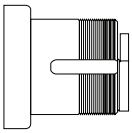


Small Format Interchangeable Core Mortise Cylinders

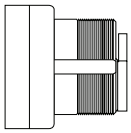




Cylinder Only



Compr. Ring & Spring



With Blocking Ring



Cylinders for Schlage L-Series Mortise Locks

	Design	Function	Core Mechanism			
			Everest Restricted (GD Suffix)	Keyed Construction (HD Suffix)	Disposable Construction (BDC Suffix)	Housing Less Core (BD Suffix)
	**L & N Escutcheons** (cylinders with compression ring and spring)	All Except L9060 Outside	80-308	80-138	80-115	80-108
		L9060P Outside	80-304	80.134	80.134	80-104
	**Sectional Trim** (cylinder with compression ring, spring and 1/4" blocking ring).	All* Except L9060 Outside	80-301	80-131	80-131	80.101
		L9060 Outside	80-304 + 36-082-050	80-134 36-082-050	80-134 36-082-050	80-104 36-082-050



L583-255
Cam for All Functions
Except L9060 Outside

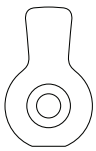


K510-680
Cam for
L9060 Outside

Notes 1. Available 605, 606, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. All cylinders are 1 3/8" long.

Mortise Cylinders with Straight Cam for Exit Devices

Number	Core Type
80-302	Everest restricted core
80-110	Disposable constr. core
80-132	Keyed constr. core
80-102	Housing less core



K510-730
Straight Cam,
Other Applications

Furnished with compression ring, spring and 1/4" blocking ring.

Notes 1. Available 605, 606, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. All cylinders are 1 3/8" long.

Small Format Interchangeable Core Cylinders for Exit Devices, Aluminum Doors



Interchangeable Core Rim Cylinders for Exit Devices

Number	Core Mechanism
80-329	Everest restricted keyway core
80-159	Keyed construction core
80-116	Disposable construction core
80-129	Less core

Available 605, 606, 609, 610, 612, 613, 625 and 626 finish.



KS21F KS72F KS92M

Padlocks

Part #	Shackle Dimensions					
	Width	Height	Depth	A	B	C
LESS CYLINDER - SMALL FORMAT INTERCHANGEABLE CORE						
CHROME BRASS BODY						
KS11A1200	1 25/32″	2 3/16″	7/8″	1/4″	3/4″	3/4″
KS11D1200	1 25/32″	2 3/16″	7/8″	1/4″	1 1/2″	3/4″
KS11F1200	1 25/32″	2 3/16″	7/8″	1/4″	2″	3/4″
KS11G1200	1 25/32″	2 3/16″	7/8″	1/4″	4″	3/4″
KS21A1200	1 25/32″	2 3/16″	7/8″	5/16″	3/4″	3/4″
KS21D1200	1 25/32″	2 3/16″	7/8″	5/16″	1 1/2″	3/4″
KS41F1200	1 25/32″	2 3/16″	7/8″	5/16″	2″	3/4″
KS21G1200	1 25/32″	2 3/16″	7/8″	5/16″	4″	3/4″
KS41A1200	1 15/16″	2 3/16″	7/8″	3/8″	3/4″	3/4″
KS41D1200	1 15/16″	2 3/16″	7/8″	3/8″	1 1/2″	3/4″
KS41F1200	1 15/16″	2 3/16″	7/8″	3/8″	2″	3/4″
KS41G1200	1 15/16″	2 3/16″	7/8″	3/8″	4″	3/4″
STEEL BODY						
KS72M1200	2 5/8″	2 3/8″	1 3/32″	7/16″	1″	7/8″
KS72F1200	2 5/8″	2 3/8″	1 3/32″	7/16″	2″	7/8″
KS82M1200	1 13/16″	3 7/16″	1 3/32″	5/16″	1″	3/4″
KS92M1200	2 1/8″	3 7/16″	1 3/16″	3/8″	1″	3/4″



Mortise Cylinders with Straight Cam for Exit Devices

Number	Core Type
80-303	Everest restricted core
80-111	Disposable constr. core
80-133	Keyed constr. core
80-103	Housing less core

Furnished with compression ring, spring and 7/16″ blocking ring.
These cylinders include set screw pack B220-050 for Adams Rite locks.



K510-711
Adams Rite
MS Cam

Cylinders for Adams Rite 4070 Series Deadlocks

Number	Core Type
80-305	Everest restricted core
80-113	Disposable constr. core
80-135	Keyed constr. core
80-105	Housing less core

Furnished with compression ring, spring and 1/4″ blocking ring



B520-378
Adams Rite
4070 Cam

Notes 1. Available 605, 606, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. All cylinders are 1 3/8″ long.



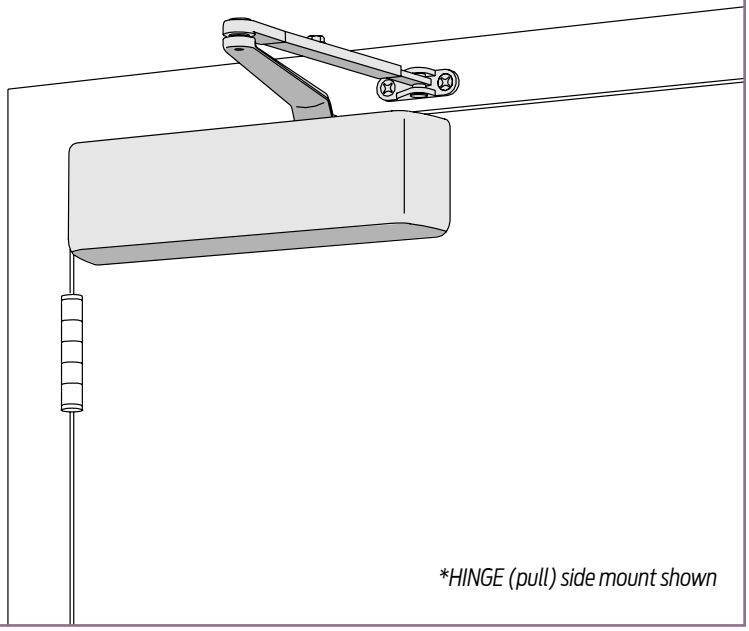
Locking Cables KC Series

Part #	Length	Diameter
LESS CYLINDER - SMALL FORMAT INTERCHANGEABLE CORE		
LOCKING CABLES		
KC215A130	2″	5/8″
KC215B130	4″	5/8″
KC215E130	6″	5/8″

4040XP SERIES

FEATURES

CLOSER MOUNTS
*HINGE (PULL) SIDE
TOP JAMB (PUSH SIDE)
PARALLEL ARM (PUSH SIDE)

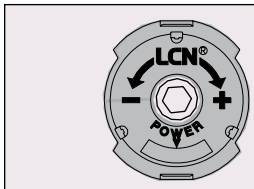


*HINGE (pull) side mount shown

The 4040XP is LCN's most durable and flexible heavy duty closer designed for institutional and other demanding high traffic applications.

- Cast Iron
- Forged Steel Arm
- Double Heat Treated Steel Pinion
- All Weather Fluid
- Non-Handed
- LCN Patented Green Dial
- Peel-n-Stick Templates for Fast and Accurate Installation
- UL & cUL Listed
- 3/4″ Journal Diameter Pinion
- Full Compliment Bearing

- Standard 4040XP Series closer shipped with regular arm, standard plastic cover, and self reaming and tapping screws.
- Non-sized cylinder is adjustable for interior doors to 5'0" and exterior doors to 4'0".
- Closer mounts hinge side, top jamb, and parallel arm on either right or left swinging doors.
- Closers to meet ADA requirements.
- Standard or optional custom powder coat finish.
- Optional plated finish on cover, arm, and fasteners.
- Optional SRI primer for installations in corrosive conditions. (Available with powder coat finishes only.)
- UL and cUL listed for self-closing doors without hold-open.
- Tested and certified under ANSI Standard A156.4, grade one.



The 4040XP Series includes the **LCN® "Green Dial" Spring Force Indicator**

MOUNTING					FINISH		COVER		CYLINDER				**ARM FUNCTION							
HINGE (PULL) SIDE	TOP JAMB (PULL)	TOP JAMB (PUSH)	PARALLEL ARM	STOP FACE	POWDER COAT	PLATED	PLASTIC	METAL	NON-HANDED	NON-SIZED	ACCESSIBILITY	DELAYED ACTION****	AVB***	REGULAR (DOUBLE)	STANDARD (SINGLE)	HOLD-OPEN	FUSIBLE LINK	EDA/HEDA	CUSH/HCUSH	SCUSH/SHCUSH	DOUBLE EGRESS
●	○	●	●	○	●	●	●	●	●	●	♿	●	○	120°	○	120°	○	180°	110°	110°	○

● AVAILABLE
○ NOT AVAILABLE

♿ *Closer available with less than 5.0 lbs. opening force on 36″ door.*
** *Maximum opening/hold-open point with standard template.*
*** *Advanced Variable Backcheck.*
**** *Delayed Action Closer incorporates standard 4041 Delay Cylinder.*

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4040XP SERIES

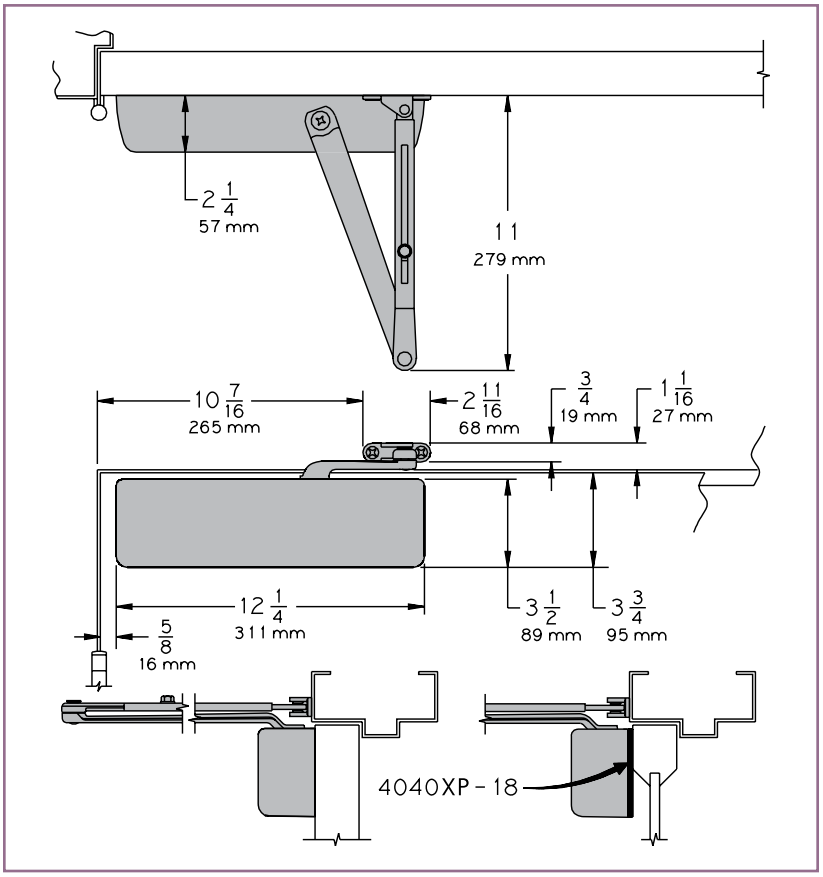
MOUNTING DETAILS

HINGE (PULL) SIDE MOUNTING

MAXIMUM OPENING

Templating allows up to 120º.

Hold-open points 90º up to 120º with hold-open arm.



- **Butt Hinges** should not exceed 5" (127 mm) in width.
- **Auxiliary Stop** is recommended at hold-open point or where a door cannot swing beyond 120º.
- **Reveal** should not exceed 3/4" (19 mm) for regular arm or hold-open arm.
- **Top Rail** less than 3-3/4" (95 mm) requires PLATE, 4040XP-18. Plate requires 2" (51 mm) minimum.
- **Clearance** of 2-3/8" (60 mm) behind door required for 90º installation.
- ***Delayed Action** Incorporates standard 4041 cylinder, without XP cylinder. Delays closing from 120º to 70º. Delay time adjustable up to approximately 1 minute.

Options

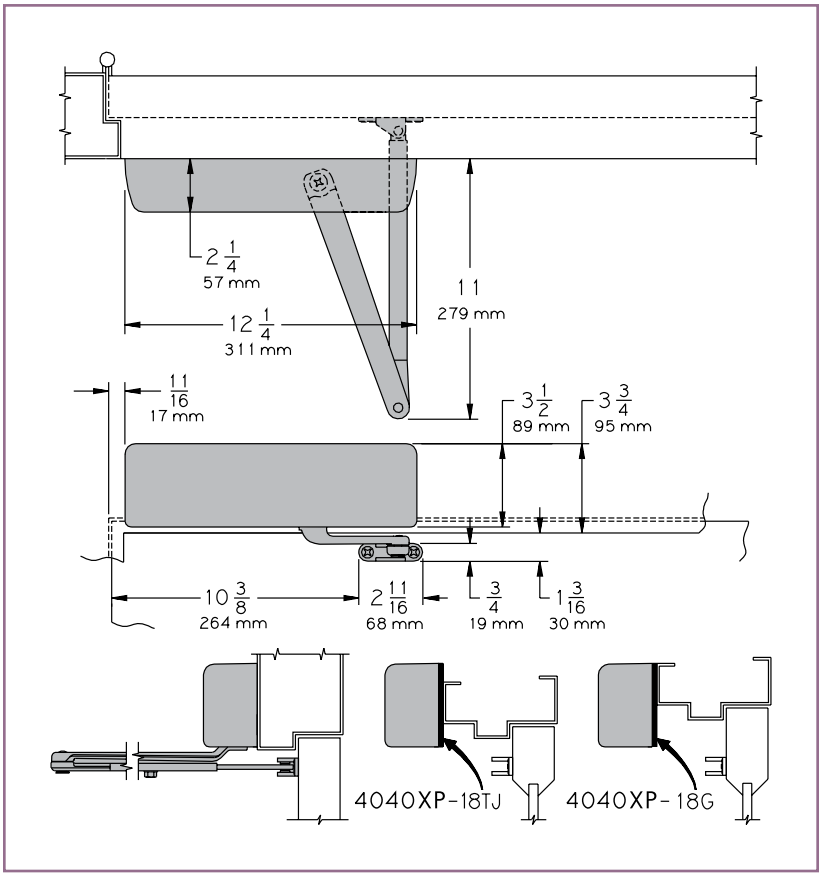
- 4041 Delayed action cylinder*.
- Hold-open arm.
- Metal cover.

Special Templates

Customized installation templates or products may be available to solve unusual applications. Contact LCN Product Support for assistance.

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4040XP SERIES



TOP JAMB (PUSH SIDE) MOUNTING

MAXIMUM OPENING

Templating allows up to 120º.

Hold-open points 85º up to 120º with hold-open arm.

- **Butt Hinges** should not exceed 5″ (127 mm) in width.
- **Auxiliary Stop** is recommended at hold-open point or where a door cannot swing beyond 120º.
- **Reveal** of 2-9/16" (65 mm) allows 120º opening for REGULAR ARM or standard Hold-open ARM. 4-13/16" (122 mm) allows up to 120º opening with LONG ARM where standard rod and shoe is replaced with optional LONG ROD AND SHOE 4040XP-79LR. Use H-LONG ARM with LONG HEAD AND TUBE, 4040XP-78HL for hold-open. 8" (203 mm) allows up to 120º opening with EXTRA LONG ARM where standard rod and shoe is replaced with optional EXTRA LONG ROD AND SHOE, 4040XP-79ELR.
- **Top Rail** requires 1-1/4″ (32 mm) minimum.
  2-1/4″ (57 mm) minimum with closer on PLATE, 4040XP-18TJ.
  3″ (76 mm) minimum with closer on PLATE, 4040XP-18G.
- **Head Frame** less than 3-1/2" (89 mm) requires PLATE, 4040XP-18TJ. With flush ceiling, use PLATE, 4040XP-18G. Either plate requires 1-3/4" (44 mm) minimum.
- ***Delayed Action** Incorporates standard 4041 cylinder, without XP cylinder. Delays closing from 120º to 70º. Delay time adjustable up to approximately 1 minute.

Options

- 4041 Delayed action cylinder*.
- Hold-open arm.
- Metal cover.

Customized installation templates or products may be available to solve unusual applications. Contact LCN Product Support for assistance.

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4040XP SERIES

MOUNTING DETAILS

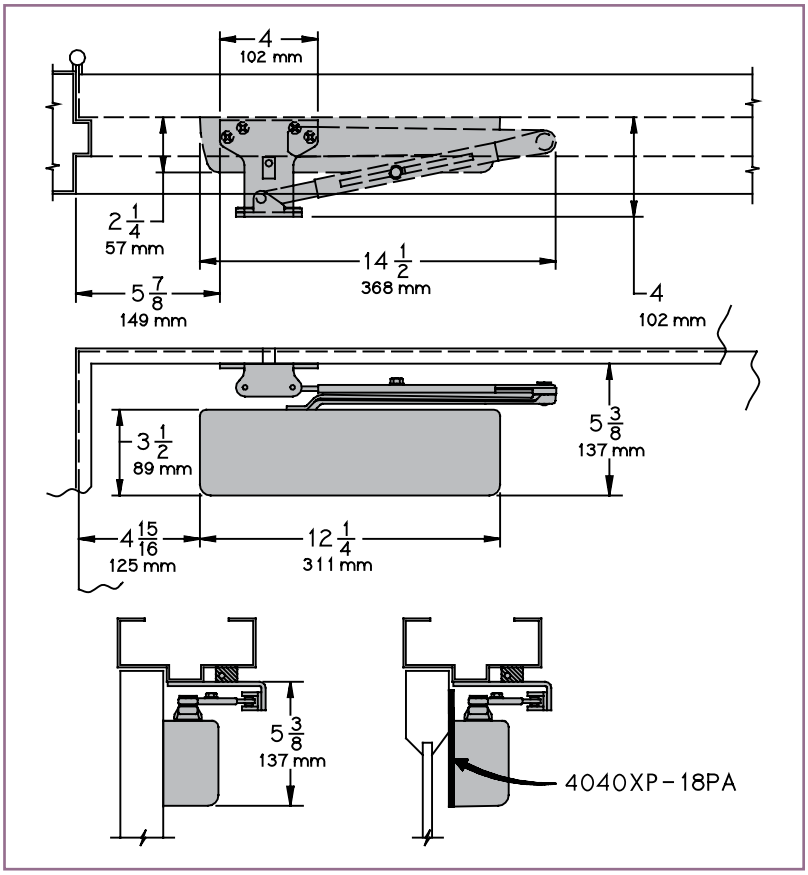
PARALLEL ARM (PUSH SIDE) MOUNTING

Optional mounting requires PA SHOE, 4040XP-62PA for regular or HOLD-OPEN arms. Add prefix "P" to closer description (eg. P4040XP). P4040XP closer includes 4040XP-201 FIFTH HOLE SPACER to support PA SHOE.

MAXIMUM OPENING

180º opening/hold-open points with all except CUSH arms.

110º opening/hold-open with CUSH arms.



- **Butt Hinges** should not exceed 5" (127 mm) in width.
- **Auxiliary Stop** is recommended at hold-open point, where the door cannot swing 180º, or where CUSH-N-STOP arm is not used.
- **Clearance** for 4040XP-62PA shoe is 4" (102 mm) from door face.
  EDA shoe projects 5-1/2" (140 mm) from door face.
  CUSH shoe projects 6" (152 mm) from door face.
- **Top Rail** less than 5-3/8" (137 mm) measured from the stop requires PLATE, 4040XP-18PA. Plate requires 2" (51 mm) minimum from the stop.
- **Head Frame** flush or rabetted requires PA SHOE ADAPTER, 4040XP-419.
- **Stop Width** minimum 1" (25 mm). CUSH arm requires minimum 1-1/2" (38 mm).
- **Blade Stop** clearance requires 1/2˝ (13mm) BLADE STOP SPACER, 4040XP-61.
- ***Delayed Action** Incorporates standard 4041 cylinder, without XP cylinder. Delays closing from 120º to 70º. Delay time adjustable up to approximately 1 minute.

Options

- 4041 Delayed action cylinder*.
- Hold-open, EDA, HEDA, CUSH, HCUSH, SPRING CUSH or SPRING HCUSH arm.
- Metal cover.

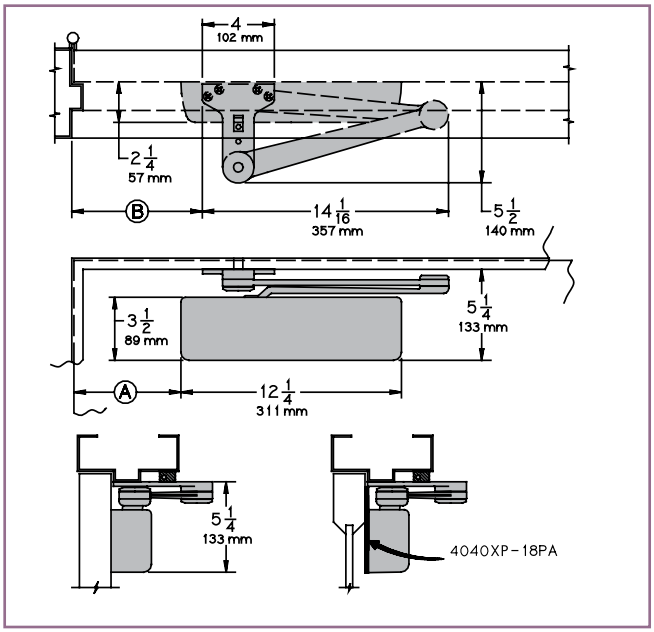
Special Templates

Customized installation templates or products may be available to solve unusual applications. Contact LCN Product Support for assistance.

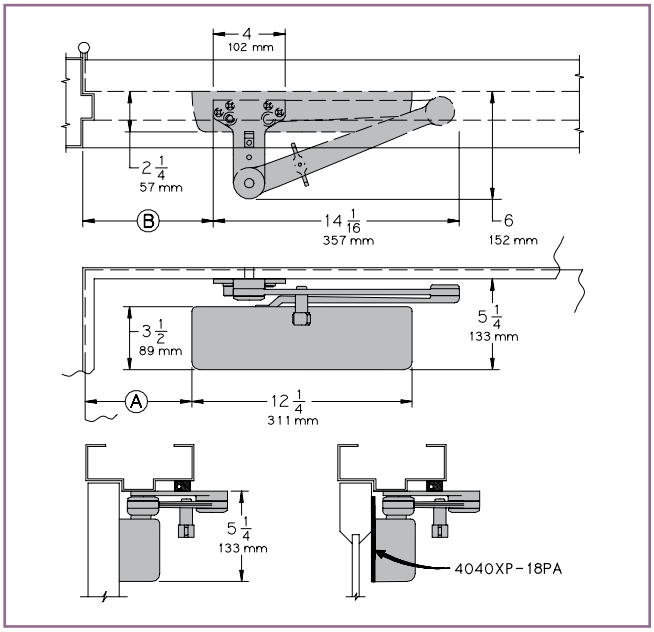
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4040XP SERIES

4040XP SERIES EDA MOUNT



4040XP SERIES CUSH MOUNT



- **Clearance** for 4040XP-62EDA is 5-1/2" (140 mm) from door face. 6" (152 mm) for CUSH.
- **Head Frame** flush or rabetted requires CUSH FLUSH PANEL ADAPTER, 4040XP-419.
- **CUSH ARM** requires SHOE SUPPORT, 4040XP-30 for fifth screw anchorage for narrow frames.
- ***Delayed Action** Incorporates standard 4041 cylinder, without XP cylinder. Delays closing from maximum opening to ; 115˚ with 180˚ template, 95˚ with 110˚ template, 85˚ with 100˚ template, 75˚ with 90˚ template. Delay time adjustable up to approximately 1 minute.

Mounting details are the same as 4040XP Series REGULAR or HOLD-OPEN except as listed below. 4040XP Series closers ordered with EDA or CUSH arms include 4040XP-201 FIFTH HOLE SPACER to support the shoe.

MAXIMUM OPENING

EDA arm can be templated for points at: 110º,
- Ⓐ = 6-3/8" (162 mm)
- Ⓑ = 7-3/4" (197 mm)

or 180º.
- Ⓐ = 2-7/8" (73 mm)
- Ⓑ = 4-1/4" (108 mm)

Hold-open points up to maximum opening with HEDA arm.

CUSH arms can be templated for opening/hold-open point at:
85º,
- Ⓐ = 7-15/16" (202 mm)
- Ⓑ = 9-1/8" (232 mm)

90º,
- Ⓐ = 7-3/16" (183 mm)
- Ⓑ = 8-1/2" (216 mm)

100º,
- Ⓐ = 6-1/16" (154 mm)
- Ⓑ = 7-1/4" (184 mm)

or 110º.
- Ⓐ = 5-1/16" (129 mm)
- Ⓑ = 6-3/8" (162 mm)

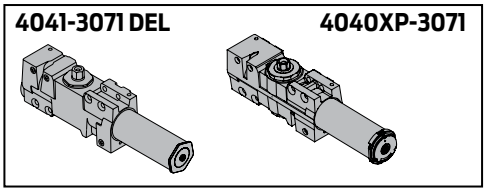
Spring Cush dead stop points are approximately 5˚ more than templated stop point. Hold open at templated stop points.

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4040XP SERIES

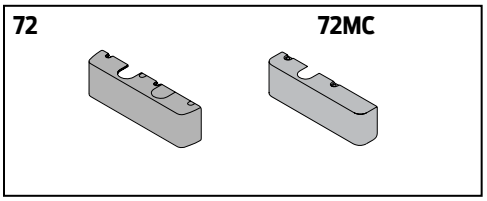
CYLINDERS

CYLINDER, 4040XP-3071
Heavy duty, non-handed cast iron cylinder assembly.
CYLINDER, 4041-3071 DEL
Cylinder used for delayed action options.



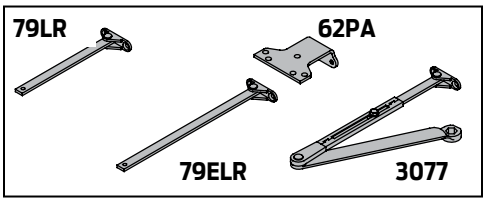
COVERS

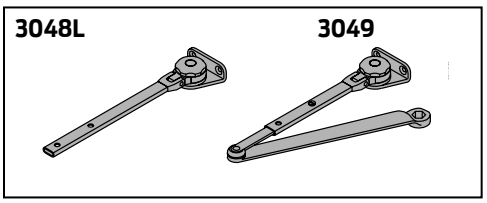
COVER, 4040XP-72
Standard, non-handed plastic cover.
METAL COVER, 4040XP-72MC
Optional, handed cover. Required for plated finishes and custom powder coat finishes.

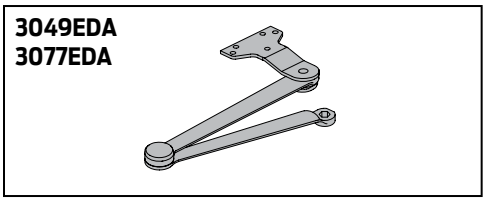


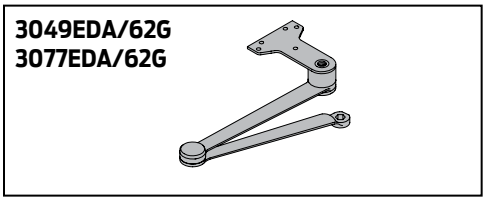
ARMS

REGULAR ARM, 4040XP-3077
Non-handed arm mounts pull side or top jamb with shallow reveal. P4041 closer includes PA SHOE, 4040XP-62PA required for parallel arm mounting.
PA SHOE, 4040XP-62PA
Required for parallel arm mounting.
LONG ARM, 4040XP-3077L
Optional non-handed arm includes LONG ROD AND SHOE, 4040XP-79LR for top jamb mount.
EXTRA LONG ARM, 4040XP-3077ELR
Optional non-handed arm includes EXTRA LONG ROD AND SHOE, 4040XP-79ELR for top jamb mount with deep reveal.
HOLD-OPEN ARM, 4040XP-3049
Optional, non-handed arm mounts pull side or top jamb with shallow reveal, hold-open adjustable shoe. 4040XP closer includes 4040XP-62PA shoe required for parallel arm mounting.
LONG HOLD-OPEN ARM, 4040XP-3049L
Optional non-handed arm includes LONG HEAD AND TUBE, 4040XP-3048L for top jamb mount.
EXTRA DUTY ARM, 4040XP-3077EDA
Non-handed parallel arm features forged, solid steel main and forearm for potentially abusive installations.
HOLD-OPEN EXTRA DUTY ARM, 4040XP-3049EDA
Handed parallel arm features forged, solid steel main and forearm for potentially abusive installations. Hold-open function is adjusted at the shoe.
EXTRA DUTY ARM WITH 62G, 4040XP-3077EDA/62G
Non-handed parallel arm features forged, solid steel main and forearm for potentially abusive installations. 62G shoe provides additional blade stop clearance.
HOLD-OPEN EXTRA DUTY ARM WITH 62G, 4040XP-3049EDA/62G
Handed parallel arm features forged, solid steel main and forearm for potentially abusive installations. 62G shoe provides additional blade stop clearance. Hold-open function is adjusted at the shoe.







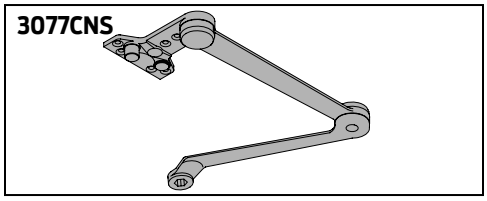


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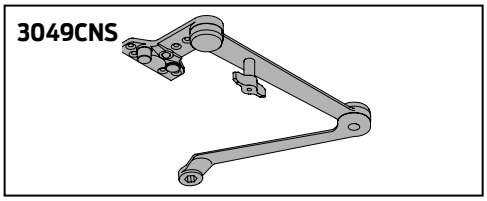
4040XP SERIES

ARMS CONT.

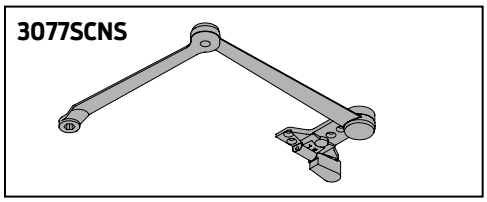
CUSH-N-STOP® ARM, 4040XP-3077CNS
Optional, non-handed parallel arm features solid forged steel main arm and forearm with stop in soffit shoe.



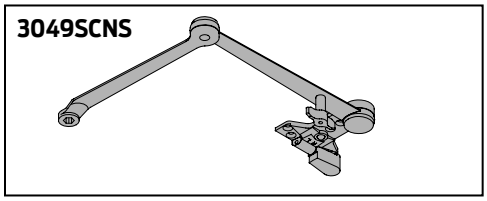
HCUSH ARM, 4040XP-3049CNS
Provides hold-open function with templated stop/hold-open points. Handle controls hold-open function.



SPRING CUSH ARM, 4040XP-3077SCNS
Optional, non-handed parallel arm for abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe.

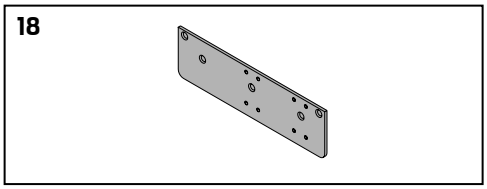


SPRING HCUSH ARM, 4040XP-3049SCNS
Optional, non-handed parallel arm for abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe. Handle controls hold-open function.



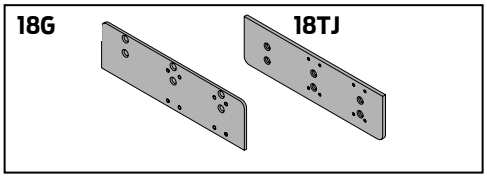
INSTALLATION ACCESSORIES

PLATE, 4040XP-18
Required for hinge side mount where top rail is less than 3-3/4" (95 mm). Plate requires minimum 2" (51 mm) minimum top rail.

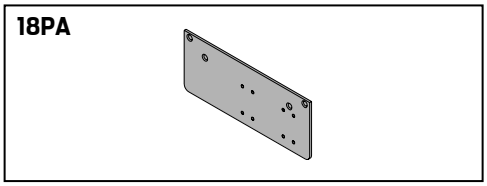


PLATE, 4040XP-18G
Locates top jamb mounted closer flush with top of head frame face in flush ceiling condition. Plate requires 1-3/4" (44 mm) minimum head frame.

PLATE, 4040XP-18TJ
Centers top jamb mounted closer vertically on head frame where face is less than 3-1/2" (89 mm). Plate requires 1-3/4" (44 mm) minimum head frame.



PLATE, 4040XP-18PA
Required for parallel arm mounting where top rail is less than 5-1/2" (140 mm), measured from the stop. Plate requires 2" (51 mm) minimum top rail.



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INSTALLATION ACCESSORIES CONT.

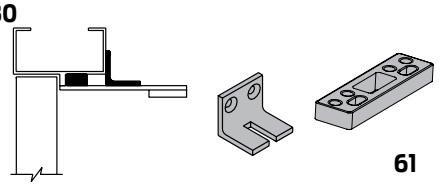
CUSH SHOE SUPPORT, 4040XP-30
Provides anchorage for fifth screw used with CUSH arms, where reveal is less than 3-1/16" (78 mm).

BLADE STOP SPACER, 4040XP-61
Required to lower parallel arm shoe to clear 1/2" (13 mm) blade stop.

PA FLUSH PANEL ADAPTER, 4040XP-419
Provides horizontal mounting surface for parallel arm shoe on single rabetted or flush frame.

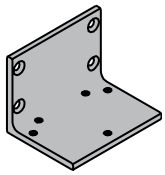
AUXILIARY SHOE, 4040XP-62A
Requires a top rail of 7" (178 mm). Optional shoe replaces -62PA for parallel arm mounting of regular arm with overhead holder/stop.

30

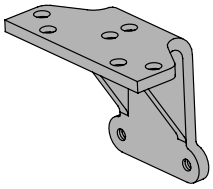


61

419



62A



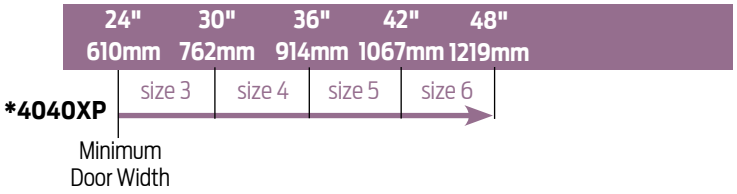
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2/14

4040XP SERIES

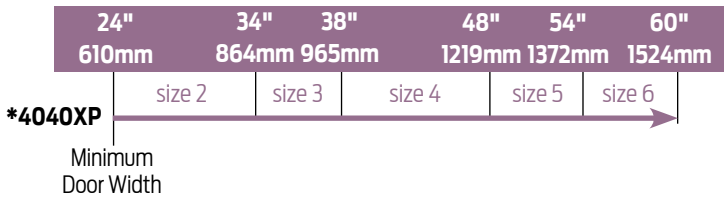
TABLE OF SIZES

4040XP cylinders are adjustable from size 1 through size 6 and is shipped set to size 3.
Closing power of 4040XP Series closers may be adjusted 50%.

EXTERIOR (and VESTIBULE) DOOR WIDTH



INTERIOR DOOR WIDTH



→ Indicates recommended range of door width for closer size.

** Adjustable Size 1 thru 6.*

REDUCED OPENING FORCE 4040XP SERIES CLOSERS

CAUTION ! Any manual door closer, including those certified by BHMA to conform to ANSI Standard A156.4, that is selected, installed and adjusted based on ADA or other reduced opening force requirements may not provide sufficient power to reliably close and latch a door.

Refer to POWER OPERATORS section for information on systems that meet reduced opening force requirements without effecting closing power.

	DOOR WIDTH	36"	42"	48"
♿	8.5* lbs.	4040XP	4040XP	4040XP
	5.0* lbs.	4040XP	4040XP	4040XP

** Maximum opening force.*

HOW-TO-ORDER 4040XP SERIES CLOSERS

1. SELECT FINISH

☐ Standard Powder Coat _____
Aluminum, Dark Bronze, Statuary, Light Bronze, Black, Brass.

Closer will be shipped with:
- STANDARD CLIP-ON COVER
- SPECIFY ARM WHEN ORDERING
- SELF-REAMING and TAPPING SCREWS,

unless options listed below are selected.

CLOSER OPTIONS

CYLINDER
☐ Delayed Action (4041 DEL)

COVER
☐ Metal (specify right or left hand) (MC)

FINISH
☐ Custom Powder Coat (RAL) _____
(handed metal cover required)
☐ Plated Finish, US _____
(handed metal cover required)
☐ SRI primer (use with powder coat finishes only)

ARM
☐ Regular (REG)
☐ Regular w/62PA (Rw/PA)
☐ Regular w/62A (R/62A)
☐ Long (LONG)
☐ Extra Long (XLONG)
☐ Hold-Open (H)
☐ Hold-Open w/62PA (Hw/PA)
☐ Long Hold-Open (HLONG)
☐ Extra Duty Arm (EDA)
☐ Extra Duty Arm with 62G (EDA/62G)
☐ Hold Open Extra Duty Arm (HEDA) (Handed)
☐ Hold Open Extra Duty Arm with 62(HEDA/62G)(Handed)
☐ Cush-N-Stop (CUSH)
☐ HCush-N-Stop (HCUSH)
☐ Spring Cush (SCUSH)
☐ Spring HCush (SHCUSH)

OPTIONAL SCREW PACKS
☐ TB* w/Self-Reaming and Tapping (TBSRT)
☐ Wood & Machine Screw (WMS)
☐ TB*, Wood & Machine Screw (TBWMS)
☐ TORX Machine Screw (TORX)
☐ TB* & TORX Machine Screw (TBTRX)
** Specify door thickness if other than 1-3/4˝.*

INSTALLATION ACCESSORIES
☐ Plate, 4040XP-18
☐ Plate, 4040XP-18TJ
☐ Plate, 4040XP-18G
☐ Plate, 4040XP-18PA
☐ CUSH Shoe Support, 4040XP-30
☐ Blade Stop Spacer, 4040XP-61
☐ Auxiliary Shoe, 4040XP-62A
☐ PA Flush Panel Adapter, 4040XP-419

SPECIAL TEMPLATE
☐ ST-_____

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LCN®

Surface mounted closer

4040XP Series



Overview

The 4040XP is LCN's most durable and flexible heavy duty closer designed for institutional and other demanding high traffic applications.

Cylinder

4040XP-3071
Cast iron cylinder assembly

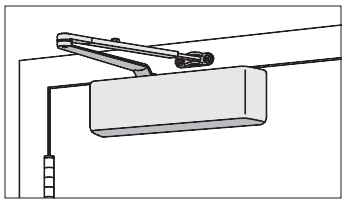
Handing
Non-handed

Sizing
Adjustable spring size 1-6, includes patented Green Dial

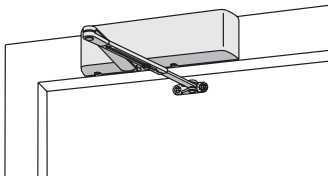
Available cylinder options

DEL	Delayed action cylinder

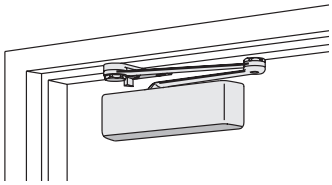
Mounting



Hinge (pull side)



Top jamb (push side)



Parallel arm (push side)

ALLEGION™

LCN®

Surface mounted closer

4040XP Series

Finishes

Powder coat finishes

689
Aluminum

690
Statuary Bronze

691
Light Bronze

693
Black

695
Dark Bronze

696
Brass

150+ additional custom colors available using the RAL numbering system

Metal plated finishes

632
Bright Brass

633
Satin Brass

639
Satin Bronze

616
Satin Bronze, Blackened

646
Satin Nickel

651
Bright Chrome

652
Satin Chrome

Available finish options

MTLPC	Brite metallic: Custom powder coat finish, which resembles that of 651 or 652 plated finish.
SRI	For installations where a higher level of protection against weather conditions, or the effects of a potentially corrosive atmosphere is required, LCN offers a special rust inhibiting (SRI) process. Ferrous metal components receive an SRI pretreatment and a standard powder coat finish of your choice, or a custom powder coat finish for a nominal additional cost. Closers treated with the SRI process exceed the 100 hour protection level available with standard LCN powder coated finishes.

Covers

Standard cover



4040XP-72
Plastic cover
- Non-handed
- Includes 4040XP-54 snap-on cover clip

Optional cover



4040XP-72MC
Metal cover
- Handed
- Required for plated finishes and custom powder coat finishes
- Optional

ALLEGION™

LCN®

Surface mounted closer

4040XP Series

Arms



4040XP-3077
Regular arm
- Non-handed
- Mounts pull side or top jamb with shallow reveal P4041 closer includes PA SHOE, 4040XP-62PA required for parallel arm mounting



4040XP-3077L
Long arm
- Non-handed
- Includes LONG ROD AND SHOE, 4040XP-79LR for top jamb mount
- Optional



4040XP-3077ELR
Extra long arm
- Non-handed
- Includes EXTRA LONG ROD AND SHOE, 4040XP-79ELR for top jamb mount with deep reveal
- Optional



4040XP-3049
Hold-open arm
- Non-handed
- Mounts pull side or top jamb with shallow reveal, hold-open adjustable shoe
- 4040XP closer includes 4040XP-62PA shoe required for parallel arm mounting
- Optional



4040XP-3049L
Long hold-open arm
- Non-handed
- Includes LONG HEAD AND TUBE, 4040XP-3048L for top jamb mount
- Optional



4040XP-3077EDA
Extra duty arm
- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- Optional



4040XP-3049EDA
Hold-open extra duty arm
- Handed
- Parallel arm features forged, solid steel main and forearm for potentially abusive installations
- Hold-open function is adjusted at the shoe
- Optional



4040XP-3077EDA/62G
Extra duty arm with 62G
- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance
- Optional



4040XP-3049EDA/62G
Hold-open extra duty arm with 62G
- Handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance. Hold-open function is adjusted at the shoe
- Optional



4040XP-3077CNS
Cush-N-Stop® Arm
- Non-handed
- Features solid forged steel main arm and forearm with stop in soffit shoe.
- Optional



4040XP-3049CNS
HCUSH arm
- Non-handed
- Hold-open function with templated stop/hold-open points
- Handle controls hold-open function
- Optional



4040XP-3077SCNS
Spring CUSH arm
- Non-handed
- For potentially abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Optional

ALLEGION™

LCN®

Surface mounted closer

4040XP Series

Arms



4040XP-3049SCNS
Spring HCUSH arm

- Non-handed
- For potentially abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Handle controls hold-open function
- Optional

LCN®

Surface mounted closer

4040XP Series

Installation accessories



4040XP-18
Plate
- Required for hinge side mount where top rail is less than 3 3/4″ (95 mm)
- Requires minimum 2″ (51 mm) minimum top rail



4040XP-18G
Plate
- Locates top jamb mounted closer flush with top of head frame face in flush ceiling condition
- Requires 1 3/4″ (44 mm) minimum head frame



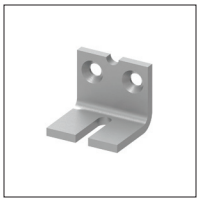
4040XP-18TJ
Plate
- Centers top jamb mounted closer vertically on head frame where face is less than 3 1/2″ (89 mm). Plate requires 1 3/4″ (44 mm) minimum head frame



4040XP-18PA
Plate
- Required for parallel arm mounting where top rail is less than 5 1/2″ (140 mm), measured from the stop
- Requires 2″ (51 mm) minimum top rail



4040XP-62PA
PA shoe
- Required for parallel arm mounting



4040XP-30
CUSH shoe support
- Provides anchorage for fifth screw used with CUSH arms, where reveal is less than 3 1/16″ (78 mm)
- Optional



4040XP-61
Blade stop spacer
- Required to lower parallel arm shoe to clear 1/2″ (13 mm) blade stop
- Optional



4040XP-419
PA flush panel adapter
- Provides horizontal mounting surface for parallel arm shoe on single rabbeted or flush frame
- Optional

LCN®

Surface mounted closer

4040XP Series

Installation accessories



4040XP-62A
Auxiliary shoe

- Requires a top rail of 7″ (178 mm)
- Shoe replaces -62PA for parallel arm mounting of regular arm with overhead holder/stop
- Optional



4040XP-54
Snap-on cover clip

- Used to secure 4040XP-72 plastic cover to cylinder body

Fasteners

Self-reaming and tapping screws included standard

Fastener pack options

TBSRT	TB[1] with self-reaming and tapping screws
WMS	Wood and machine screw
TBWMS	TB[1], wood and machine screw
TORX	TORX machine screw
TBTRX	TB[1] and TORX machine screw

1 Specify door thickness if other than 1 3/4"

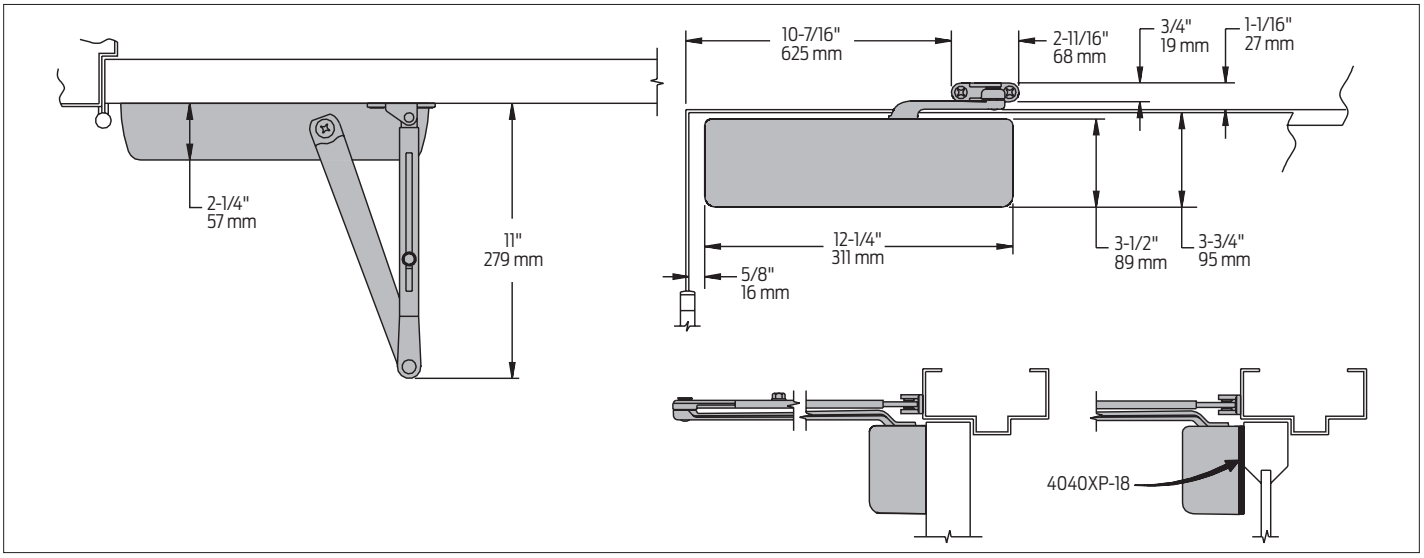
LCN®

Surface mounted closer

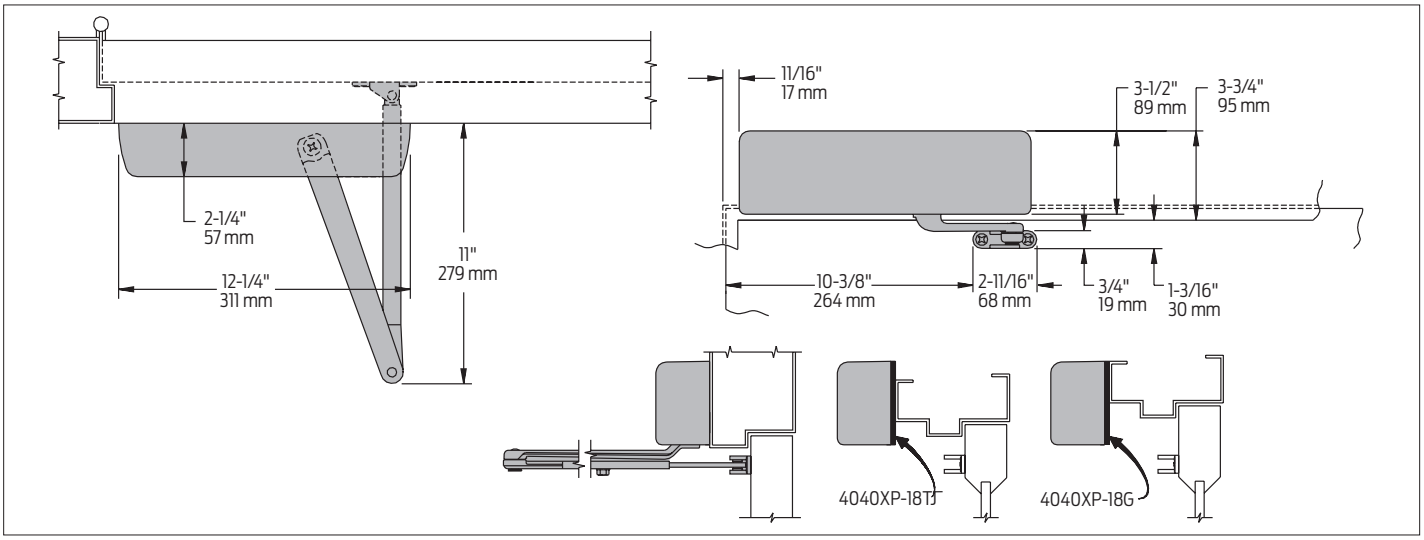
4040XP Series

Dimensions and mounting

Hinge (pull) side mounting



Top jamb (push side) mounting



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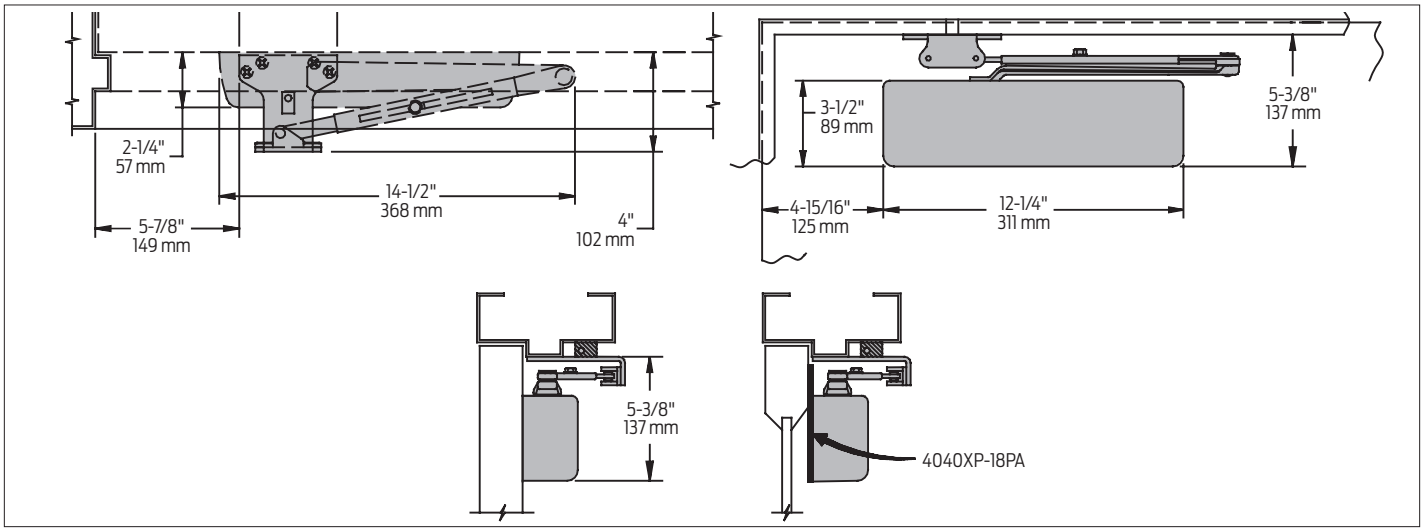
LCN®

Surface mounted closer

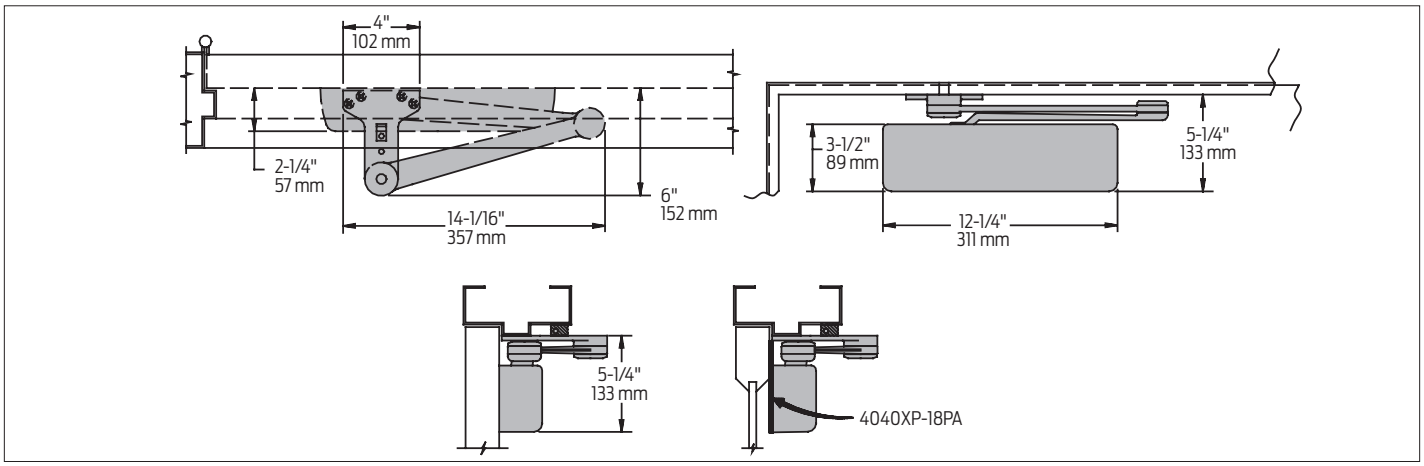
4040XP Series

Dimensions and mounting

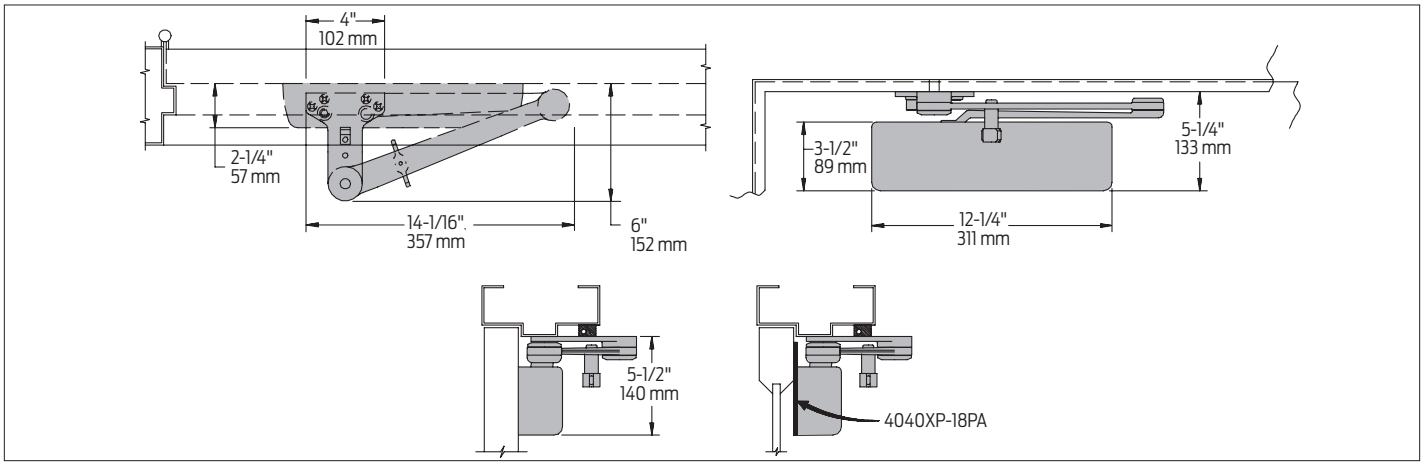
Parallel arm (push side) mounting



EDA mount



CUSH mount



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LCN®

Surface mounted closer

4040XP Series

Specifications

Accessibility	Available with less than 5.0 lbs. opening force on 36" door
Certifications/ approvals	▪ Grade 1 - ANSI A156.4 ▪ UL 10C ▪ Meets BAA - Buy American Act
Degree of operation	Hinge (pull) side Max opening: 120° Hold open: 90-120° Top jamb (push side) mount Max opening: 120° Hold open: 85-120° Parallel arm with 62PA Max opening: 180° Hold open: 180° EDA Max opening: 180° Hold open: 180° Cush and spring cush Max opening: 110° Hold open: 110°
Environmental conditions	▪ Approved for interior use ▪ Approved for exterior use (SRI coated only) ▪ LCN's standard all weather fluid performs to temperature ranges from 120°F (49°C) to -30°F (-35°C) ▪ LCN's powder coat finish surpasses 100 hours of salt spray which is over four times the ANSI standard for corrosion resistance.
Warranty	30 years
Standard features	▪ Cast iron body ▪ Full complement bearing ▪ 1 1/2" diameter piston ▪ 11/16" diameter double heat treated pinion journal

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IVES

Protection Plates

8400 Series Protection Plates

- Door protection plates are available in .050" thick brass, stainless steel or aluminum; and 1/8" thick high impact polyethylene in clear or black.
- Bevel edge options; specify B4E for all four edges.
- Mounting screw pack furnished standard, 16 screws per pack. Optional screw packs are available for TEK or TORK screw heads. Refer to the following chart for ordering.
- Specify NMH for no mounting holes. (Not available on 8402)
- Specify NMH-A for no mounting holes with adhesive. (Not available on 8402)
- Specify CS for counter sunk mounting holes.
- Specify ERS prepped with extra row of screws.

Kickplate Gasket Tape Tape is recommended when using a brass plate on a metal door to reduce tarnishing from electrolytic oxidation. One tape pack will cover an the perimeters of a 8" x 34" kickplate. Order 8401 Gasket Tape.



8400 Protection Plate
8402 (UL)* Protection Plate

**UL mark appears in upper right corner. Factory supplied screws must be used.*

Number of screw packs required by plate size (specify TEK Screws or TORK screws).

	22"-25"	26"-33"	34"-41"	42"-48"
4"-8"	1	1	1	1
9"-16"	1	1	1	1
17"-24"	1	1	1	2
25"-32"	1	1	2	2
33"-40"	1	2	2	2
41"-48"	2	2	2	2

Finishes *brass 24" x 48" max. size*

US Number	US3	US4	US10	US10B	US15	US26	US26D
BHMA	605	606	612	613	619	625	626

Finishes *stainless steel*

US Number	US32	US32D
BHMA	629	630

Finishes *aluminum*

US Number	US28
BHMA	628

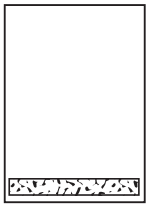
Finishes *plastic*

Clear and Black

Residential Grade Kickplates available Carded only, finishes PA28, PA3, PA619, PA716, B3, B505, B619, B716

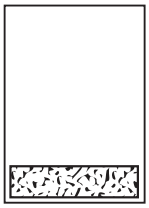
IVES

Protection Plates



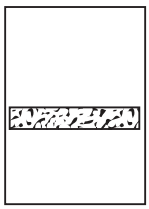
Mop Plates

- Protect the bottom of the pull side of door subject to cleaning and mopping procedures.
- Size Ranges:4" to 6" high, 22" to 48" wide



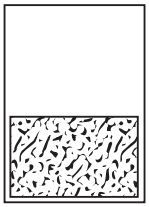
Kick Plates

- Protect the bottom of the push side of doors subject to scuffing from foot traffic.
- Recommended for all doors subject to normal use (especially doors using a closer).
- Size Ranges: 8" to 24" high, 22" to 48" wide



Stretcher Plates

- Protect doors at specific areas where consistent contact is made by stretchers, service carts or other equipment.
- Usually applied to push side of doors.
- Specify "B4E" Option for beveled edges.
- Size Ranges: 6" to 8" high, 22" to 48" wide



Armor Plates

- Protect lower half of doors from abuse by hard carts, trucks and rough usage.
- Usually applied to push side of single doors and both sides of double acting doors.
- Size Ranges: 26" to 48" high, 22" to 48" wide



FS436
Meets ANSI/BHMA 156.16, L12141 for brass or bronze and L32141 for aluminum.



FS438
Meets ANSI/BHMA 156.16, L12141 for brass or bronze and L32141 for aluminum.

FS436 Dome Stop
FS438 Dome Stop

- FS436 for doors without threshold.
- FS438 for doors with threshold or undercut doors.
- Heavy-Duty Cast Dome Stops constructed of brass, bronze or aluminum.
- Packed with wood screw and plastic anchor.

Replaceable gray, non-marring rubber bumper.

Dimensions

FS436
Overall Height: 1”
Base Height: 3/16”
Base Diameter: 1-3/4” x 2” Oval

FS438
Overall Height: 1-3/8”
Base Height: 9/16”
Base Diameter: 1-3/4” x 2” Oval

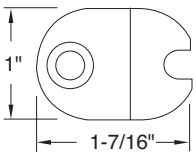
Finishes *brass*

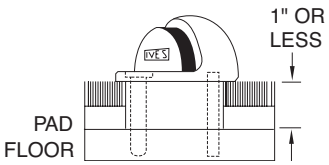
Ives Number	US3	US4	US5	US10	US10B	US15	US26	US26D	B716
BHMA	605	606	609	612	613	619	625	626	

Finishes *aluminum*

Ives Number	US28
BHMA	628







R435 Riser for FS436 Dome Stop
R437 Riser for FS438 Dome Stop

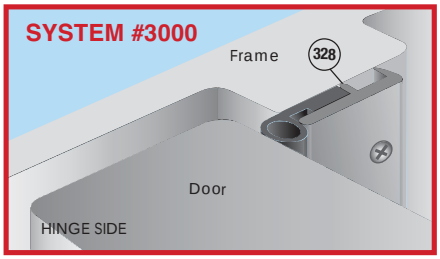
- Extruded aluminum, mill finish.
- R435 for conversion of FS436 Dome Stop to carpet installation.
- R437 For conversion of FS438 Dome Stop to carpet installation.
- Packed with wood screws, lead shield and stud. Specify Tampin (TPN) if required.

Dimensions

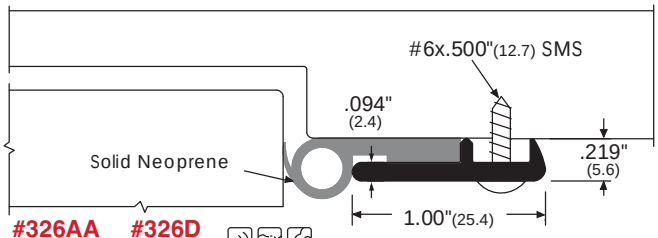
Available in 1/4”, 3/8”, 1/2”, 5/8”, 3/4” and 1” height.

Hinge 20-020 – SAN B400 Renovation Project Specifications

Note: A = Aluminium AA = Clear Anodized
B = Bronze D = Dark Bronze Anodized
G = Gold Anodized PVC = Polyvinyl, clear
ZAG = Ligature-Resistant gasketing

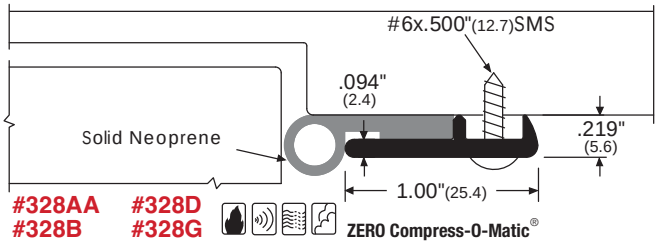


System #3000 consists of:
#328 (hinge side)
#326 (head & lock sides)



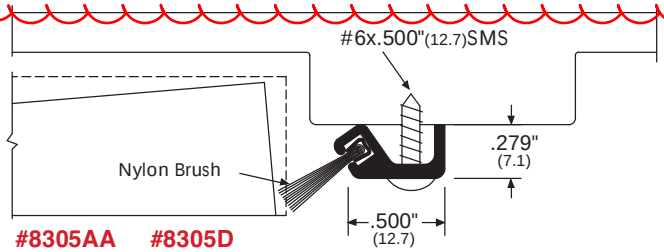
#326AA #326D
#326B #326G
#326PVC

ZERO Compress-O-Matic®
ZAG option available

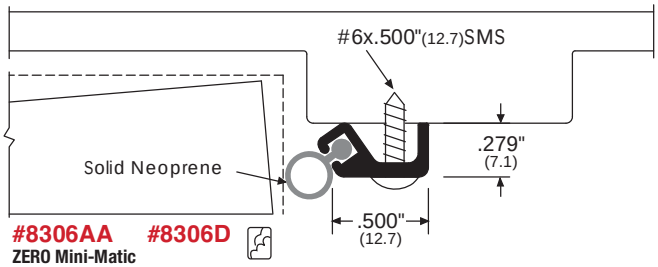


#328AA #328D
#328B #328G
#328PVC

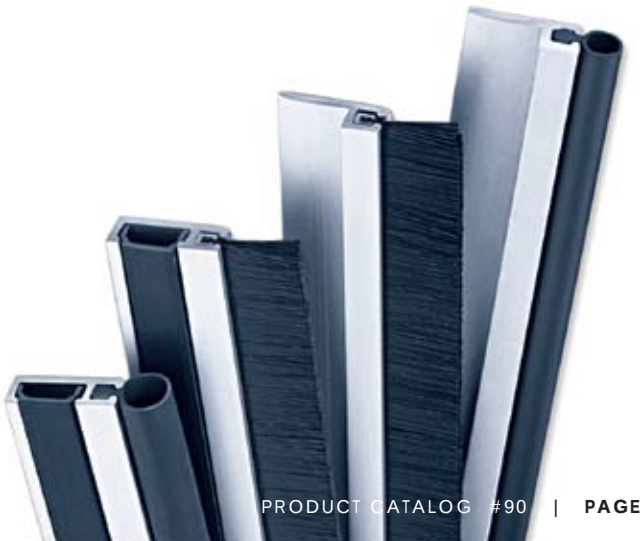
ZERO Compress-O-Matic®
ZAG option available

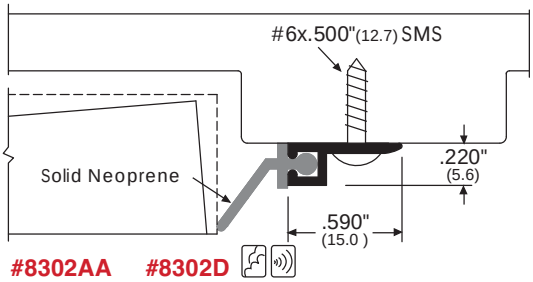


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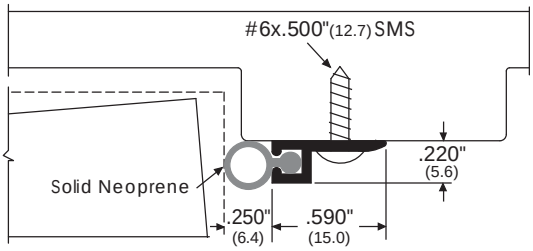


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ZERO Mini-Matic

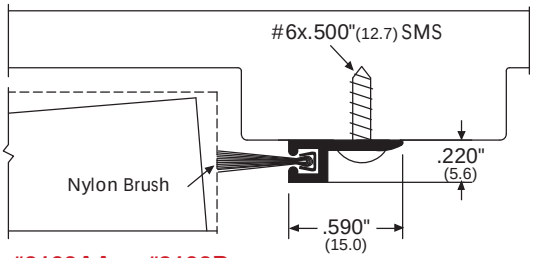




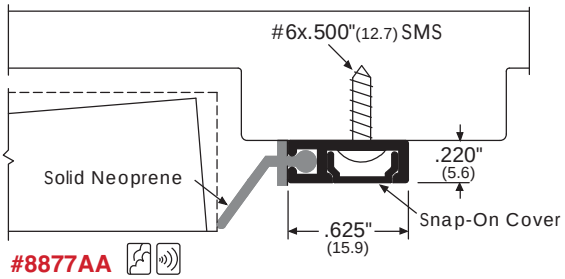
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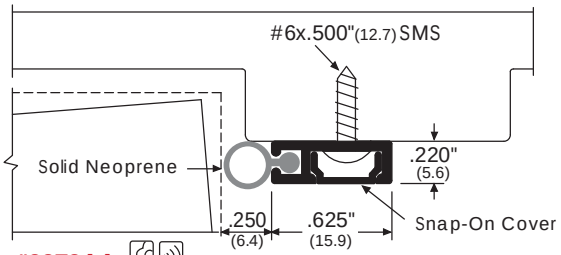
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ZERO Mini-Matic



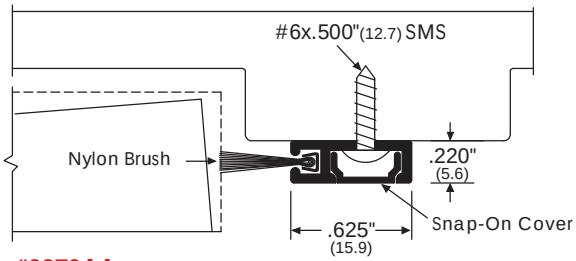
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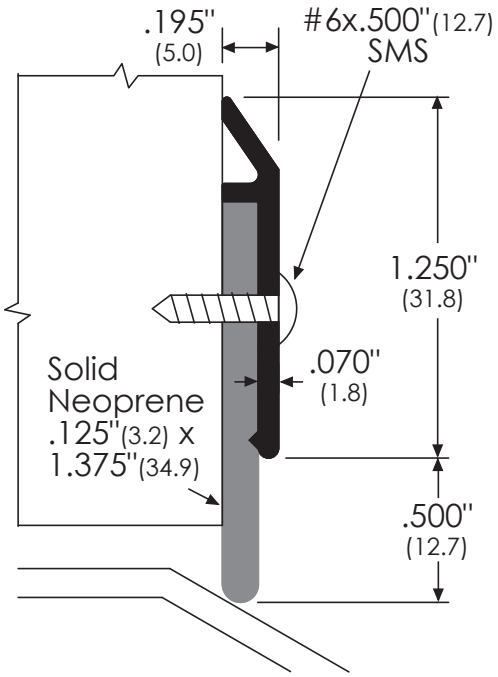
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FIRE PERFORMANCE

This seal is non-flammable

SMOKE PERFORMANCE

The rubber seal in this gasket provides protection from smoke infiltration in accordance with provisions of NFPA 101 Life Safety Code and NFPA 80 Standard for Fire Doors and Other Opening Protectives



Legend:
A = Aluminum
D = Dark Bronze Anodized

ANSI/BHMA

#39A / 39D	R3B434

ZERO INTERNATIONAL
415 Concord Avenue
Bronx, NY 10455
tel: 718.585.3230
fax: 718.292.2243
email: zero@zerointernational.com
web site: www.zerointernational.com

Part No: 39

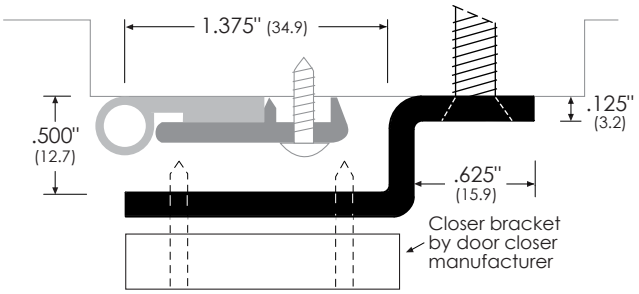
Notes:

Part Description:

Door Sweep

- Surface Mounted Aluminum with Neoprene

Provided By:	Customer Name:	Job No:	Date:



ZERO INTERNATIONAL

415 Concord Avenue
Bronx, NY 10455
tel: 718.585.3230
fax: 718.292.2243
email: zero@zerointernational.com
web site: www.zerointernational.com

Part No: 328SPB

Notes:

Part Description:

Head and Jamb Specialty

- Closer Bracket Plate
- Steel Primed Painted 6"wide

Provided By:	Customer Name:	Job No:	Date:

SCHLAGE

PS902

2 amp power supply

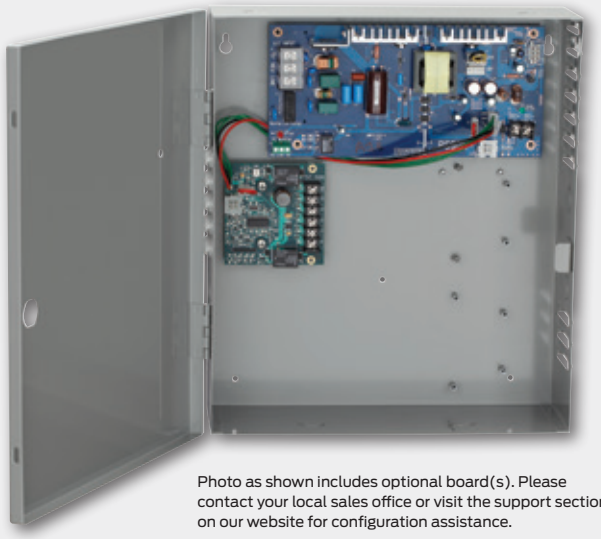


Photo as shown includes optional board(s). Please contact your local sales office or visit the support section on our website for configuration assistance.

Overview

The Schlage comprehensive line of power supplies and option boards was designed to address the changing needs of the access control market.

Installation is simplified by utilizing a flat mounting design and polarized locking connectors for option boards. This design eliminates the need for racks and side connectors. The flat mounting of the option boards also provides for easier access to the terminal blocks for connection of electrified devices (such as electrified strikes, electromagnetic locks, card readers, etc.).

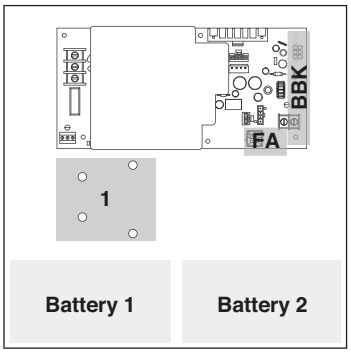
Common to the line of PS900 Series power supplies is a constant output rating at both 12v and 24v settings, universal 120 VAC to 240 VAC input, and polarized option board connectors. New fire alarm interface board mounting allows outputs to be configured as switched (power cut) or unswitched (power continues) when signal is provided.

Features and benefits

- 2A @ 12/24 VDC constant output, field selectable with jumper
- Provides low-voltage, Class 2, filtered and regulated power
- Universal 120-240 VAC, fused primary input
- Single polarized option board connector
- AC input and DC output monitoring circuit with LED indicators
- Externally visible AC input indicator with isolated SPDT contacts
- High-voltage protective cover for AC circuitry (not shown)
- Battery back-up board auto-selects voltage
- Optional Fire Alarm plug-in board available
- UL 294, ULC-S318, RoHS, and FCC Part 15 certified

Configuration options

Available option board, fire alarm and battery backup connection locations:



Exit device support

Von Duprin QEL	Up to 2[1]
Von Duprin EL	None
Falcon EL	None

1. Requires the use of one 900-2RS option board

PS902 power supply specifications

Specification	Description
Input voltage	120/240 VAC, 50/60 Hz, universal input
Output voltage	2A @ 12 or 24 VDC Field selectable with jumper Switching supply, 5% regulation, 240mVpp max ripple
Enclosure	Grey/baked enamel 14" x 12" x 4" (H x W x D) Eight ½" x ¾" knockouts NEMA Grade 1 Hinged cover with lock down screws
Operating temperature	32º - 120ºF (0º - 49ºC)
Certifications	ANSI/UL 294 ULC-S318 RoHS FCC Part 15 Class 2
Battery backup (install on main board)	900-BB: Battery backup board only 900-BBK: Battery backup kit (backup board plus battery pack)
Available option boards	900-FA: Plug-in fire alarm (install on main or option board) 900-2RS: 2 Relay option board capable of individual or sequential operation for single and pair door applications 900-4R: 4 Relay option board 900-4RL: 4 Relay option board with integrated logic and individual or sequential operation capability for controlling security interlocks, auto operators, and time delay function 900-8F: Fused, 8 zone option board 900-8P: PTC, 8 zone option board
AC primary fuse size	3.15A, 250v, 5 x 20mm
Battery fuse size	7.5A 32v ATO blade style
DC output protection	Overload protection - current limited foldback circuit
Indicators	LED indicators: - AC input (visible on outside of enclosure) - DC output Isolated SPDT contacts to monitor AC power status
Weight (power supply)	Approx. 9.0 lbs
Weight (each battery)	4.0 lbs
AC input termination	3 position terminal block with protective cover Wire capacity: 10 AWG max.
DC output termination	2 position terminal block Wire capacity: 12 AWG max.
Option board connectors	1
Fire alarm board connector	Yes
Keylock	Optional
Accessories	900-BAT: Backup battery pack

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aptiQ ■ LCN ■ SCHLAGE ■ STEELCRAFT ■ VON DUPRIN

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www.allegion.com/us

SECTION 08 80 0

GLAZING

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.

1.02 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, storefront framing, and.
2. Glazing sealants and accessories.

1.03 DEFINITIONS

A. Glass Manufacturers: 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. CBC: California Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.04 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.05 SUBMITTALS

A. Submit in accordance with Section 01 33 00 “Submittals.”

B. Product Data: For each type of product.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

1. Tinted glass.
2. Coated glass.
3. Laminated glass.
4. Insulating glass.

D. Glazing Accessory Samples: For sealants, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Qualification Data: For manufacturers of insulating-glass units with sputter-coated, low-E coatings.

H. Product Certificates: For glass. Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

I. Product Test Reports: For coated glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

J. Sample Warranties: For special warranties.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.08 FIELD 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. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.09 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to 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. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Guardian Glass; SunGuard.
2. Oldcastle BuildingEnvelope.
3. Pilkington North America.
4. Vitro.
5. Or equal.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.02 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
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. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.03 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.04 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Reflective-Coated Vision Glass: ASTM C 1376.

2.05 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.06 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction Aluminum with black, color anodic finish.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.07 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.08 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; 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; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.09 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of 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).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit 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. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine framing, glazing channels, and stops, 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 systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.03 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

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.

G. 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.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape 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.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

A. Cut compression gaskets to 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. Installation with Drive-in Wedge Gaskets: 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. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.07 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. 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. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces 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.

3.08 MONOLITHIC GLASS SCHEDULE

A. Basis of Design Assemblies: Subject to compliance with requirements, provide glazing assemblies as indicated in “Glazing Types” schedule on Drawings.

3.09 LAMINATED GLASS SCHEDULE

A. Basis of Design Assemblies: Subject to compliance with requirements, provide glazing assemblies as indicated in “Glazing Types” schedule on Drawings.

3.10 INSULATING GLASS SCHEDULE

A. Basis of Design Assemblies: Subject to compliance with requirements, provide glazing assemblies as indicated in “Glazing Types” schedule on Drawings.

END OF SECTION

SECTION 08 88 13

FIRE-RATED GLAZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fire-resistance-rated glazing.

1.02 DEFINITIONS

A. Fire-Resistance-Rated Glazing: Glazing that prevents spread of fire and smoke and radiant heat; used in rated wall and door applications 60 minutes and above without size limitations.

B. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

C. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.03 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.04 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. Glass Samples: For each type of glass product; 12 inches square.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For glass testing agency.

B. Product Certificates: For each type of glass and glazing product.

C. Sample Warranties: For special warranties.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

1.08 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Glass: For each glass type, obtain from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.03 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.04 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.05 FIRE-RESISTANCE-RATED GLAZING

A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing in accordance with ASTM E119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that glazing is approved for use in walls, and fire-resistance rating in minutes.

C. Fire-Resistance-Rated Framing and Doors: Fire-resistance-rated glazing with 60-, 90-, and 120-minute ratings requires framing and doors from glass supplier, tested as an assembly complying with ASTM E119 or UL 263.

D. Fire-Resistance-Rated Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with 16 CFR 1201, Category II.

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. Pilkington North America.
b. SAFTI FIRST Fire Rated Glazing Solutions.
c. Technical Glass Products.
d. Vetrotech Saint-Gobain.

2.06 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications 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. GE Construction Sealants; Momentive Performance Materials Inc.
b. The Dow Chemical Company.
c. Tremco Incorporated.

2. Verify sealant complies 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. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

C. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; 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; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.07 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

C. Perimeter Insulation for Fire-Resistance-Rated Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.08 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit 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.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.03 GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. 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.

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 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.

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 in accordance with requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape 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.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

A. Cut compression gaskets to 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. Installation with Drive-in Wedge Gaskets: 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.

D. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.07 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. 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. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces 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.

3.08 FIRE-RESISTANCE-RATED GLAZING SCHEDULE

A. Glass Type: 60-minute fire-resistance-rated glazing complying with ASTM E119 or UL 263 in a tested assembly of glass and framing with 450 deg F temperature-rise limitation; fire-resistance-rated laminated glass with intumescent interlayers.

END OF SECTION

SECTION 09 24 00

CEMENT PLASTERING

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.

1.02 SUMMARY

A. Section Includes:

1. Exterior vertical plasterwork (stucco).
2. Exterior horizontal and nonvertical plasterwork (stucco).

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.05 QUALITY ASSURANCE

A. 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 mockups for each substrate and finish texture indicated for cement plastering, including accessories. Size: 100 sq. ft. in surface area.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.07 FIELD CONDITIONS

A. Comply with ASTM C926 requirements.

B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 deg F.
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.

2.02 METAL LATH

A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.

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. Stockton Products.
b. Alabama Metal Industries Company; a Gibraltar Industries company.
c. CEMCO; California Expanded Metal Products Co.
d. ClarkDietrich.
e. MarinoWARE.
f. Phillips Manufacturing Co.
g. Or equal.

2. Diamond-Mesh Lath: Self-furring, 3.4 lb/sq. yd..
3. Flat-Rib Lath: Rib depth of not more than 1/8 inch, 3.4 lb/sq. yd..

B. Paper Backing: FS UU-B-790a, Type I, Grade D, Style 2 vapor-permeable paper. Provide layer, lapped, at exterior locations where portland cement plaster is applied over air barrier.

2.03 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

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. Stockton Products.
   b. Alabama Metal Industries Company; a Gibraltar Industries company.
   c. CEMCO; California Expanded Metal Products Co.
   d. ClarkDietrich.
   e. MarinoWARE.
   f. Phillips Manufacturing Co.
   g. Or equal.

2. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A653/A653M, G60 zinc coating.
3. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
4. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
5. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.

   a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
   b. Smallnose cornerbead with perforated flanges; use on curved corners.
   c. Bullnose cornerbead, radius 3/4 inch minimum, with expanded flanges; use at locations indicated on Drawings.

6. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
7. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
8. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
9. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch wide; with perforated flanges.

2.04 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in cement plaster.

C. Bonding Compound: ASTM C932.

D. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.

E. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

F. Penetration Flashing: Comply with the following:

1. Basis of Design Product: Flashing panels manufactured by Quickflash Weatherproofing Products.
2. Material: Manufacturer's standard one-piece product consisting of combination of high-density polyethylene (HDPE) and low-density polyethylene (LDPE).
3. Location: Provide at mechanical, electrical, and similar penetrations in exterior walls.

2.05 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.

B. Sand Aggregate: ASTM C897.

C. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

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. Omega Products International, Inc.
b. California Stucco Products Corp.
c. Dryvit Systems, Inc.
d. El Rey Stucco Solutions; a Parex USA, Inc. brand.
e. Senergy; BASF Corp.
f. Sto Corp.
g. Stuc-O-Flex International, Inc.
h. Or equal.

2. Exterior Cement Plaster Color: “Custom” MiraCosta Stucco.” Match Sherwin Williams 6403-99689 A06W00153. Comply with the following pigment blend

CE	COLOR CAST	OZ.	32	64	128
W1	White	2	42		1
B1	Black	2	31		
R2	Maroon	2	18	1	
Y3	Deep Gold	8	27		1

2.06 PLASTER MIXES

A. General: Comply with ASTM C926 for applications indicated. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Base-Coat Mixes for Use over Unit Masonry and Concrete: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows: Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

D. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, 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.

3.02 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.03 INSTALLATION, GENERAL

A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

3.04 INSTALLING PAPER BACKING

A. General: Cover sheathing with paper backing as follows:

1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.

B. Paper Backing: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails. Install paper backing over sheathing substrate separate from metal lath. Apply layer with joints lapped..

3.05 INSTALLING METAL LATH

A. Metal Lath: Install according to ASTM C1063.

1. Partition Framing and Vertical Furring: Install flat-diamond-mesh lath.
2. Flat-Ceiling and Horizontal Framing: Install 3/8-inch rib lath.
3. Curved-Ceiling Framing: Install flat-diamond-mesh lath.
4. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.06 INSTALLING PENETRATION FLASHING

A. Apply penetration flashing at openings and where indicated complying with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant paper backing at bottom and sides of openings.
4. Lap weather-resistant paper backing over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.07 INSTALLING ACCESSORIES

A. Install according to ASTM C1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install lath-type, external-corner reinforcement at exterior locations.
2. Install cornerbead at interior locations.

C. Control Joints: Locate as approved by Architect 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.

3.08 PLASTER APPLICATION

A. General: Comply with ASTM C926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry and concrete substrates for direct application of plaster.

C. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch total thickness, as follows: Portland cement mixes.

D. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 3/4-inch total thickness for metal lath on concrete, as follows: Portland cement mixes.

E. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 3/8-inch thickness on masonry, as follows: Portland cement mix.

F. Ceilings; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 1/4-inch thickness on concrete, as follows: Portland cement mix.

G. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

H. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

3.09 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.10 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

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.

1.02 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.

B. Related Requirements: Section 06 16 00 "Sheathing" for gypsum sheathing for exterior walls.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For the following products: Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.04 QUALITY ASSURANCE

A. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following: Each level of gypsum board finish indicated for use in exposed locations.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 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.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install 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.

PART 2 - PRODUCTS

2.01 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.

2.02 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.03 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

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. USG Corporation.
   b. American Gypsum.
   c. CertainTeed Gypsum.
   d. Georgia-Pacific Gypsum LLC.
   e. National Gypsum Company.
   f. PABCO Gypsum.
   g. Or equal.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

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. USG Corporation.
b. CertainTeed Gypsum.
c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. PABCO Gypsum.
f. Or equal.

2. Thickness: 1/4 inch.
3. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C1396/C1396M.

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. USG Corporation.
b. American Gypsum.
c. CertainTeed Gypsum.
d. Georgia-Pacific Gypsum LLC.
e. National Gypsum Company.
f. PABCO Gypsum.
g. Or equal.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

D. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

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. USG Corporation.
b. American Gypsum.
c. CertainTeed Gypsum.
d. Georgia-Pacific Gypsum LLC.
e. National Gypsum Company.
f. PABCO Gypsum.
g. Or equal.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.04 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

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. USG Corporation.
b. CertainTeed Gypsum.
c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. Or equal.

2. Core: 5/8 inch, Type X.

2.05 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet, 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.

2.06 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.

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 taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

2.07 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

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. Pecora Corporation.
c. Specified Technologies, Inc.
d. USG Corporation.
e. Or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C840.

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. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. 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.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. 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.

H. 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 C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.03 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Where required for fire-resistance-rated assembly and vertical surfaces unless otherwise indicated.
2. Flexible Type: Apply in double layer at curved assemblies.
3. Ceiling Type: Ceiling surfaces.
4. Mold-Resistant Type: As indicated on Drawings.

B. 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 horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. 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-shaped furring members, 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.

D. 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 instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. 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.

3.04 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.05 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

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.
5. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

3.06 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.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 3: Where indicated on Drawings.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
4. Level 5: Where indicated on Drawings. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

3.07 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

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

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

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.

1.02 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 “Submittals.”

B. Product Data: For each type of product.

C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

D. Delegated-Design Submittal: For seismic restraints for ceiling systems. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. 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-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.

F. Qualification Data: For testing agency.

G. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

H. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

I. Field quality-control reports.

J. Maintenance Data: For finishes to include in maintenance manuals.

K. 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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.04 QUALITY ASSURANCE

A. 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 typical ceiling area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, 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

2.01 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7and 2019 CBC,

C. 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: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 50 or less.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL or from the listings of another qualified testing agency.

2.03 ACOUSTICAL PANELS

A. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

B. Basis of Design Product: Design is based on products indicated in “Material and Finish Schedule” on Drawings. Subject to compliance with requirements, provide Armstrong World Industries, Inc. ceiling system or equal.

C. Antimicrobial Treatment: Manufacturer's standard broad spectrum, 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, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.04 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch-wide metal caps on flanges.

1. Product: Armstrong “Suprafine XL” suspension members. ICC Report: ESR-1308. Main Tee: Model 7501. Cross Tee: Model XL 7540.
2. Structural Classification: Heavy-duty system.
3. End Condition of Cross Runners: Override (stepped) or butt-edge type.
4. Face Design: Flat, flush.
5. Cap Material: Cold-rolled steel.
6. Cap Finish: Painted white.

2.05 ACCESSORIES

A. 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.

B. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

E. Hold-Down Clips: Manufacturer's standard hold-down.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.06 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. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.

2.07 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.01 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.

3.02 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 unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.03 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

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 and, if permitted with fire-resistance-rated ceilings, 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 to structure 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. 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.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. 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.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

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. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

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. 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 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. 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.
3. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated. Hold-Down Clips: Space 24 inches o.c. on all cross runners.
4. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.04 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.05 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections: Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7 and 2019 CBC.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Within each test area, testing agency select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and test them for 200 lbf of tension; it also select one of every two postinstalled anchors used to attach bracing wires to concrete and test them for 440 lbf of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.06 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.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

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.

1.02 SUMMARY

A. Section Includes:

1. Thermoplastic-rubber base.
2. Rubber molding accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.
4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For resilient base and stair products and accessories, indicating compliance with requirements for low-emitting materials.
6. Environmental Product Declaration: For each product.
7. Health Product Declaration: For each product.
8. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.04 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 or more than 90 deg F.

1.05 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 resilient products during the following 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. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. 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."

2.02 THERMOPLASTIC-RUBBER BASE

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. Armstrong World Industries, Inc.
2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
3. Johnsonite; a Tarkett company.
4. Roppe Corporation, USA.
5. VPI Corporation.
6. Or equal.

B. Product Standard: ASTM F1861, Type TP (rubber, vulcanized).

1. Group: I (solid, homogeneous).
2. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient floor coverings.

C. Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As indicated in “Materials and Finish Schedule” in Drawings.

2.03 RUBBER MOLDING ACCESSORY

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. Roppe Corporation, USA.
2. VPI Corporation.
3. Or equal.

B. Profile and Dimensions: As indicated.

C. Locations: Provide rubber molding accessories in areas indicated.

D. Colors and Patterns: As indicated by manufacturer's designations.

2.04 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated. Adhesives shall have a VOC content of 50 g/L or less.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Installation of resilient products indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.03 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 practical 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.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches Insert dimension in length. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length. Cope corners to minimize open joints.

3.04 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 floor covering that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.

3. Damp-mop horizontal 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 subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 096723

RESINOUS FLOORING

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.

1.02 SUMMARY

A. Section Includes: Resinous flooring systems.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Sustainable Design Submittals: Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

C. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

1.05 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each resinous flooring component, from manufacturer.

B. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 96-inch-square floor area selected by Architect. Include 96-inch length of integral cove base with inside and outside corner.
2. Simulate finished lighting conditions for Architect's review of mockups.
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.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. 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."

B. Flammability: Self-extinguishing according to ASTM D635.

2.02 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.03 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base. Basis of Design Product RF-1: Subject to compliance with requirrements, provide Flowcrete Americas, Flowfresh Ultra Flakes seamless flooring system, or equal.

B. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Smooth.
3. Overall System Thickness: 1/4 inch.

C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated. Formulation Description: High solids.

D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

E. Body Coats:

1. Resin: Epoxy.
2. Formulation Description: High solids.
3. Type: Pigmented.
4. Application Method: Troweled or screeded.
5. Aggregates: Colored quartz (ceramic-coated silica).

F. Grout Coat:

1. Resin: Epoxy.
2. Formulation Description: 100 percent solids.
3. Type: Pigmented.
4. Thickness of Coat: 3/16 inch minimum.

G. Topcoats: Sealing or finish coats.

1. Resin: Urethane.
2. Formulation Description: 100 percent solids.
3. Type: Pigmented.
4. Number of Coats: One.
5. Thickness of Coats: 4-5 mils.
6. Finish: Gloss.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows: Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
    b. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.02 INSTALLATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

D. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.

E. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.

F. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.03 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

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.

1.02 SUMMARY

A. Section Includes: Modular carpet tile.

B. Related Requirements: Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile 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.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.

10. Transition details to other flooring materials.

C. Samples: 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 Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, 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 tile.

1.07 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.08 QUALITY ASSURANCE

A. 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 as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

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 tiles 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 tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile 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 edge raveling, snags, and runs.
    b. Dimensional instability.
    c. Excess static discharge.
    d. Loss of tuft-bind strength.
    e. Loss of face fiber.
    f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE

A. Carpet/Carpet Tile Flooring: Comply with CBC Section 11B-302.2.

1. Carpet shall be securely attached and shall have a firm cushion, pad, or backing, or no cushion or pad. It shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be 1/2-inch maximum.
2. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length. Carpet edges shall comply with CBC 11B-303.

2.02 CARPET TILE

A. Basis of Design Products: Design is based on products indicated in “Material and Finish Schedule” on Drawings, or equal. .

B. Color: Match Architect's samples.

C. Pattern: Match Architect's samples.

D. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows: 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.

E. Performance Characteristics:

1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.
4. Tuft Bind: Not less than 5 lbf according to ASTM D1335.
5. Delamination: Not less than 3.5 lbf/in. 4 lbf/in. Insert value according to ASTM D3936.
6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
9. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
10. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.03 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.01 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 tile performance.

B. Examine carpet tile 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 200 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 tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

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 tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile 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 tile manufacturer.

F. Extend carpet tile 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 tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.04 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 91 13

EXTERIOR PAINTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
4. Galvanized metal.
5. Aluminum (not anodized or otherwise coated).
6. Stainless-steel flashing.
7. Plastic trim fabrications.
8. Exterior gypsum board.

B. Related Requirements: Section 09 91 23 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.02 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.03 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 Samples on rigid backing, 8-1/2 by 11 inches. Submit three paper “draw down” samples of each color.
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. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
3. VOC content.

1.04 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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.05 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. 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.

1.06 DELIVERY, STORAGE, AND HANDLING

A. 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.

1.07 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 snow, 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

2.01 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. Benjamin Moore & Co.
2. Dunn-Edwards Corporation. (Basis of Design)
3. Sherwin-Williams Company (The).
4. Vista Paint.
5. Or equal.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

C. Sheen: Match sheen of Campus Buildings unless indicated otherwise.

2.02 PAINT, GENERAL

A. 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.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

C. Colors: As indicated in a color schedule.

2.03 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will 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 noncomplying 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.

PART 3 - EXECUTION

3.01 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.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Portland Cement Plaster: 12 percent.
5. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.02 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. 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. 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. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

G. 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.

H. 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.

I. Aluminum Substrates: Remove loose surface oxidation.

J. 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.

K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

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 and switch gear.
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.

3.04 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.

3.05 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.

3.06 EXTERIOR PAINTING SCHEDULE

A. Concrete and Portland Cement Plaster Substrates, Non-traffic Surfaces: 100% Acrylic Flat.

1. Prime Coat:

a. Benjamin Moore & Co: 023 Fresh Start Primer
b. Dunn Edwards: UGPR00 Utra-Grip Premium
c. Sherwin-Williams Company (The): A24W300 Loxon Primer
d. Vista Paint: 4600 Uniprime II

2. Intermediate Coat:

a. Benjamin Moore & Co: W105 Regal Select 100% Acrylic Flat
b. Dunn Edwards: EVSH10 Evershield Flat Exterior
c. Sherwin-Williams Company (The): K33 Duration Flat
d. Vista Paint: 2000 Duratone 100% Acrylic Flat

3. Finish Coat:

a. Benjamin Moore & Co: W105 Regal Select 100% Acrylic Flat
b. Dunn Edwards: EVSH10 Evershield Flat Exterior
c. Sherwin-Williams Company (The): K33 Duration Flat
d. Vista Paint: 2000 Duratone 100% Acrylic Flat

B. CMU Substrates: 100% Acrylic Flat.

1. Prime Coat:

a. Benjamin Moore & Co: 285 Block Filler
b. Dunn Edwards: SBPR00 Block Filler
c. Sherwin-Williams Company (The): B25W25 Block Filler
d. Vista Paint: 040 Block Filler

2. Intermediate Coat:

a. Benjamin Moore & Co: W105 Regal Select 100% Acrylic Flat
b. Dunn Edwards: EVSH10 Evershield Ext Flat
c. Sherwin-Williams Company (The): K32 Duration Flat
d. Vista Paint: 2000 Duratone 100% Acrylic Flat

3. Finish Coat:

a. Benjamin Moore & Co: W105 Regal Select 100% Acrylic Flat
b. Dunn Edwards: EVSH10 Evershield Ext Flat
c. Sherwin-Williams Company (The): K32 Duration Flat
d. Vista Paint: 2000 Duratone 100% Acrylic Flat

C. Ferrous Metal Substrate: 100% Acrylic Semi Gloss.

1. Prime Coat:

a. Benjamin Moore & Co: M04 Acrylic Prime
b. Dunn Edwards: UGPR00 Utra-Grip Premium
c. Sherwin-Williams Company (The): B66W1 DTM Acrylic Primer
d. Vista Paint: 9600 Protec Primer

2. Intermediate Coat:

a. Benjamin Moore & Co: W096 Regal Select 100% Acrylic Semi Gloss
b. Dunn Edwards: EVSH40 Evershield Semi Gloss Exterior
c. Sherwin-Williams Company (The): K34 Duration Gloss
d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

3. Finish Coat:

a. Benjamin Moore & Co: W096 Regal Select 100% Acrylic Semi Gloss
b. Dunn Edwards: EVSH40 Evershield Semi Gloss Exterior
c. Sherwin-Williams Company (The): K34 Duration Gloss
d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

D. Galvanized and Aluminum Metal Substrates: 100% Acrylic Semi Gloss.

1. Prime Coat:

a. Benjamin Moore & Co: M04 Acrylic Prime
b. Dunn Edwards: GAPR00 Galv-Alum Premium
c. Sherwin-Williams Company (The): B66A50 DTM Bonding Primer
d. Vista Paint: 4800 Metal Pro Primer

2. Intermediate Coat:

a. Benjamin Moore & Co: W096 Regal Select 100% Acrylic Semi Gloss
b. Dunn Edwards: EVSH40 Evershield Semi Gloss Exterior
c. Sherwin-Williams Company (The): K34 Duration Gloss
d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

3. Finish Coat:

a. Benjamin Moore & Co: W096 Regal Select 100% Acrylic Semi Gloss
b. Dunn Edwards: EVSH40 Evershield Semi Gloss Exterior
c. Sherwin-Williams Company (The): K34 Duration Gloss
d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

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.

1.02 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
4. Cast iron.
5. Galvanized metal.
6. Aluminum (not anodized or otherwise coated).
7. Wood.
8. Gypsum board.

B. Related Requirements: Section 09 91 13 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.03 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

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.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

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.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. LEED Submittals: Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8-1.2 by 11 inches. Submit three paper “draw down” samples of each color.
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. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.05 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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.06 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. 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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. 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.

1.08 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

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co. Montvale, New Jersey 07653; www.benjaminmoore.com.
2. Dunn-Edwards Paint Co. (The), Los Angeles, California 90058; www.dunnedwards.com.
3. Sherwin-Williams Company (The), Cleveland, Ohio 44115; www.sherwin-williams.com.
4. Vista Paint Corporation (The), Fullerton, California 92831; www.vistapaint.com.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.02 PAINT, GENERAL

A. 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.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 50 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust Preventative Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 50 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

C. 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."

D. Colors: As indicated in a color schedule.

2.03 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will 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 noncomplying 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.

PART 3 - EXECUTION

3.01 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.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.02 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. 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. 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. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. 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.

H. 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.

I. Aluminum Substrates: Remove loose surface oxidation.

J. 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.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

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.

3.04 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.

3.05 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.

3.06 INTERIOR PAINTING SCHEDULE

A. Concrete and Portland Cement Plaster Substrates, Non-traffic Surfaces: 100% Acrylic Semi Gloss

1. Prime Coat:

   a. Benjamin Moore & Co: 023 Fresh Start Primer
   b. Dunn Edwards: UGPR00 Utra-Grip Premium
   c. Sherwin-Williams Company (The): A24W300 Loxon Primer
   d. Vista Paint: 4600 Uniprime II

2. Intermediate Coat:

   a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
   b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
   c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
   d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

3. Finish Coat:

   a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
   b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
   c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
   d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

B. CMU Substrates: 100% Acrylic Semi Gloss

1. Prime Coat:

   a. Benjamin Moore & Co: 285 Block Filler
   b. Dunn Edwards: SBPR00 Block Filler
   c. Sherwin-Williams Company (The): B25W25 Block Filler
   d. Vista Paint: 040 Block Filler

2. Intermediate Coat:

   a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
   b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
   c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
   d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

3. Finish Coat:

   a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
   b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
   c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
   d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

C. Ferrous Metal Substrate: 100% Acrylic Semi Gloss

1. Prime Coat:

   a. Benjamin Moore & Co: M04 Acrylic Prime
   b. Dunn Edwards: UGPR00 Utra-Grip Premium
   c. Sherwin-Williams Company (The): B66W1 DTM Acrylic Primer
   d. Vista Paint: 9600 Protec Primer

2. Intermediate Coat:

   a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
   b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
   c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
   d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

3. Finish Coat:

    a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
    b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
    c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
    d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

D. Galvanized and Aluminum Metal Substrates: 100% Acrylic Semi Gloss

1. Prime Coat:

    a. Benjamin Moore & Co: M04 Acrylic Prime
    b. Dunn Edwards: GAPR00 Galv-Alum Premium
    c. Sherwin-Williams Company (The): B66A50 DTM Bonding Primer
    d. Vista Paint: 4800 Metal Pro Primer

2. Intermediate Coat:

    a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
    b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
    c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
    d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

3. Finish Coat:

    a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
    b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
    c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
    d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

E. Wood Substrates: 100% Acrylic Semi Gloss

1. Prime Coat:

    a. Benjamin Moore & Co: 023 Fresh Start Primer
    b. Dunn Edwards: EZPR00 E-Z Prime Premium
    c. Sherwin-Williams Company (The): B51W20 PrepRite Pro Block
    d. Vista Paint: 4200 Terminator II

2. Intermediate Coat:

    a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
    b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
    c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
    d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

3. Finish Coat:

    a. Benjamin Moore & Co: 551 Regal Select 100% Acrylic Semi Gloss
    b. Dunn Edwards: SPMA40 Suprema Semi Gloss Interior
    c. Sherwin-Williams Company (The): A98 Duration Semi Gloss
    d. Vista Paint: 8400 Carefree Semi Gloss 100% Acrylic

F. Gypsum Wallboard Substrates: 100% Acrylic Eggshell

1. Prime Coat:

a. Benjamin Moore & Co: 023 Fresh Start Primer
b. Dunn Edwards: VNPR00 PVA Sealer
c. Sherwin-Williams Company (The): B28W08111 Premium Wall & Wood Primer
d. Vista Paint: 1100 Hi Build PVA Sealer

2. Intermediate Coat:

a. Benjamin Moore & Co: 549 Regal Select 100% Acrylic Eggshell
b. Dunn Edwards: SPMA30 Suprema Eggshell Interior
c. Sherwin-Williams Company (The): A97 Duration Satin
d. Vista Paint: 8300 Carefree Eggshell 100% Acrylic

3. Finish Coat:

a. Benjamin Moore & Co: 549 Regal Select 100% Acrylic Eggshell
b. Dunn Edwards: SPMA30 Suprema Eggshell Interior
c. Sherwin-Williams Company (The): A97 Duration Satin
d. Vista Paint: 8300 Carefree Eggshell 100% Acrylic

END OF SECTION

SECTION 10 11 00

VISUAL DISPLAY UNITS

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.

1.02 SUMMARY

A. Section Includes: Visual display board assemblies.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 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.
2. Include electrical characteristics for motorized units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
3. Show locations and layout of special-purpose graphics.
4. Include sections of typical trim members.

C. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each visual display unit, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Sample Warranties: For manufacturer's special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

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 mockup of typical visual display unit as shown on Drawings. Include accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units 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.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units 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.

1.10 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: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; 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.

2.02 VISUAL DISPLAY BOARD ASSEMBLY

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. Claridge Products and Equipment, Inc.
2. MooreCo, Inc: www.moorecoinc.com.
3. Polyvision Corporation (Nelson Adams): www.polyvision.com.
4. Or equal.

B. Visual Display Board Assembly: Field or factory fabricated.

1. Assembly: markerboard.
2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.
5. Mounting Method: Direct to wall.

C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated. Color: White.

D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape. Aluminum Finish: Clear anodic finish.

E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

F. Combination Assemblies: Provide hidden spline between abutting sections of visual display panels.

G. Chalktray: Manufacturer's standard; continuous. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

H. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.

1. Size: 1 inch high by full length of visual display unit.
2. Map Hooks: Two map hooks for every 48 inches of display rail or fraction thereof.
3. Aluminum Color: Match finish of visual display assembly trim.

2.03 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.

1. Face Sheet Thickness: 0.0239 inch uncoated base metal thickness.
2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.04 TACKBOARD PANELS

A. Tackboard Panels:

1. Facing: 1/4-inch-thick, plastic-impregnated cork.
2. Core: Manufacturer's standard.

2.05 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout; with surface-burning characteristics indicated.

C. Hardboard: ANSI A135.4, tempered.

D. Particleboard: ANSI A208.1, Grade M-1.

E. MDF: ANSI A208.2, Grade 130.

F. Fiberboard: ASTM C208 cellulosic fiber insulating board.

G. Extruded Aluminum: ASTM B221, Alloy 6063.

H. 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.

2.06 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 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.

2.07 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.01 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 visual display units.

C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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 visual display boards.

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 visual display units and wall surfaces.

D. Prepare recesses for sliding visual display units as required by type and size of unit.

3.03 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

C. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

3.04 CLEANING AND PROTECTION

A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motorized, sliding visual display units.

END OF SECTION

SECTION 10 14 23.16

ROOM-IDENTIFICATION PANEL SIGNAGE

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.

1.02 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.03 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.04 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. 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. Room-Identification Signs: Full-size Sample.
2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
3. Exposed Accessories: Full-size Sample of each accessory type.
4. Full-size Samples, if approved, will be returned to Contractor for use in Project.

D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.09 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special 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.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and 2019 CBC.

B. Signage and Graphics: Raised characters shall comply with CBC 11B-703.2 and as follows:

1. Depth: It shall be 1/32 inch ((0.8 mm) minimum above their background and shall be sans serif uppercase and be duplicated I Braille.

2. Height: It shall be 5/8 inch (15.9 mm) minimum and 2 inches (51 mm)maximum based on the height of the uppercase letter :I". CBC Section 11B-703.2.5.
3. Finish and Contract: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background or dork characters on a light background. CBC Section 11B-703.5.1.
4. Proportions: It shall be selected from fonts where the width of the uppercase letter "O" is 60% minimum and 110% maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15% maximum of the height of the character. CBC Sections 11B-703.2.4 and 11B-703.2.6.
5. Character Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8.
6. Format: Text shall be in a horizontal format. CBC Section 11B-703.2.9.
7. Braille: It shall be contracted (Grade 2) and shall comply with CBC Section 11B-703.3 and 11B-703.4. Braille dots shall have a domed or rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
8. Mounting Height: Tactile characters on signs shall be located 48 inches minimum to the baseline of the lowest Braille cells and 60 inches maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. CBC Section and Figure 11B-703.4.1.
9. Mounting Location: A tactile sign shall be located per CBC Section and Figure 11B-703.4.2, as follows:

    a. Alongside a single door at the latch side.
    b. On the inactive leaf at double doors with one active leaf.
    c. To the right of the right hand door at double doors with two active leafs.
    d. On the nearest adjacent wall where there is not wall space at the latch side of a single door or at the right side of double doors with two active leafs.
    e. So that a clear floor space of 18 inches by 18 inches minimum, centered on the tactile characters, is provided beyond the arch of any door swing between the closed position and 45 degree open position.

10. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40 inches minimum above finish floor or ground.
11. Pictograms shall comply with CBC Section 11B-703.6.
12. Symbols of accessibility shall comply with CBC Section 11B-703.7.
13. Variable message signs shall comply with CBC Section 11B-703.8.

2.02 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

2.03 SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

D. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

E. 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.

2.04 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, 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 devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
    b. Fastener Heads: Use oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

E. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

2.05 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. Provide rabbets, lugs, and tabs 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. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

2.06 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

2.07 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

C. 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.

PART 3 - EXECUTION

3.01 INSTALLATION

A. 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.

B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. 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.
3. 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.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
6. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.

3.02 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 Owner.

END OF SECTION

SECTION 10 26 00

WALL AND DOOR PROTECTION

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.

1.02 SUMMARY

A. Section Includes: Chair rail.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For each type of wall and door protection showing locations and extent. Include plans, elevations, sections, and attachment details.

D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below: Chair rail: 12 inches long. Include examples of joinery, corners, end caps, and field splices.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of handrail.

B. Material Certificates: For each type of exposed plastic material.

C. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F. Store wall-guard covers in a horizontal position.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; 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.

2.03 WALL GUARDS

A. Chair Rail: Heavy-duty, PVC-free assembly consisting of continuous snap-on plastic cover installed over concealed retainer; designed to withstand impacts.

B. Basis of Design Product: Design is based on products indicated in "Material and Finish Schedule" on Drawings. Subject to compliance with requirements, provide Acrovyn rail system or equal.

1. Cover: Extruded rigid plastic, minimum 0.100-inch wall thickness; in dimensions and profiles indicated on Drawings. Color and Texture: As selected by Architect from manufacturer's full range.
2. Retainer Clips: Manufacturer's standard impact-absorbing clips designed for heavy-duty performance.
3. Bumper: Continuous, resilient bumper cushion(s).
4. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
5. Accessories: Concealed splices and mounting hardware.
6. Mounting: Surface mounted directly to wall.

2.04 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Material: Stainless-steel sheet, Type 304.

    a. Thickness: Minimum 0.0500 inch.
    b. Finish: Directional satin, No. 4.

2. Wing Size: Nominal 1-1/2 by 1-1/2 inches.
3. Corner Radius: 1/8 inch.
4. Mounting: Oval head, countersunk screws through factory-drilled mounting holes.

2.05 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by protection product manufacturer. Adhesives shall have a VOC content of 70 g/L or less.

2.06 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.07 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.03 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
3. Adjust end caps as required to ensure tight seams.

3.04 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 10 44 13

FIRE PROTECTION CABINETS

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.

1.02 SUMMARY

A. Section Includes: Fire-protection cabinets for portable fire extinguisher.

B. Related Requirements: Section 10 44 16 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.03 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following: Schedules and coordination requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.06 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.03 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

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. JL Industries, Inc.; a division of the Activar Construction Products Group.
b. Babcock-Davis.
c. Guardian Fire Equipment, Inc.
d. Larsens Manufacturing Company.
e. Nystrom.
f. Potter Roemer LLC.
g. Or equal.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Recessed Cabinet: Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as drywall bead.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Acrylic plastic, clear, 1/8 inch thick,

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide continuous hinge, of same material and finish as trim,, 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.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

    a. Location: Applied to cabinet door.
    b. Application Process: Decals or Pressure-sensitive vinyl letters.
    c. Lettering Color: Red.
    d. Orientation: Vertical.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
    b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Color: Match Architect's sample.

2.04 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. Miter corners and grind smooth.
3. 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. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.05 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. 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.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

B. Examine and coordinate with other subcontractors to confirm rough-in locations, rough-in dimensions, and potential conflicts requiring resolution before installation of cabinets.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification: Apply decals or vinyl lettering at locations indicated.

3.04 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.

END OF SECTION

SECTION 10 44 16

FIRE EXTINGUISHERS

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.

1.02 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements: Section 10 44 13 "Fire Protection Cabinets."

1.03 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.

1.04 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.06 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.07 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 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction. Provide fire extinguishers approved, listed, and labeled by FM Global.

C. Comply with requirements from Title 19 C.C.R.

2.02 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket 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. JL Industries, Inc.; a division of the Activar Construction Products Group.
b. Amerex Corporation.
c. Babcock-Davis.
d. Guardian Fire Equipment, Inc.
e. Kidde Residential and Commercial Division.
f. Larsens Manufacturing Company.
g. Nystrom.
h. Potter Roemer LLC.
i. Or equal.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.

5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.03 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

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. JL Industries, Inc.; a division of the Activar Construction Products Group.
b. Ansul by Johnson Controls Company.
c. Babcock-Davis.
d. Buckeye Fire Equipment Company.
e. Guardian Fire Equipment, Inc.
f. Kidde Residential and Commercial Division.
g. Larsens Manufacturing Company.
h. Nystrom.
i. Potter Roemer LLC.
j. Or equal.

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface. Orientation: Vertical.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated. Coordinate installation of supporting backing.

END OF SECTION

SECTION 11 52 13

AUDIOVISUAL EQUIPMENT – PROJECTION SCREENS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The work under this section includes all final design, all labor, material, equipment, supplies, Alignment, testing, transportation and accessories required to furnish and install a complete projection screen installation as indicated on the drawings and as specified herein.

B. It is the intent of the Drawings and Specifications, for the Contractor to design, provide and install a complete, fully operational, and tested system.

C. All miscellaneous system components including, but not limited to, plenum cables, speakers, signal converters, interface panels and components, termination equipment, patch panels, backboards, converters, matrix switchers, digital video extenders, controllers, digital signal processors, amplifiers, pre-amps, custom faceplates, mounting hardware, fasteners, racks, cabinets, and any other related items shall be furnished and installed complete under this section, such that the system shall perform all functions listed herein in compliance with all of the specified requirements.

1.02 SUMMARY

A. This Section includes permanently affixed audiovisual projection screens as required to complete the work of this project.

1.03 RELATED DOCUMENTS

A. Section 270500 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

D. Related Sections include the following:

1. Division 26 Sections for electrical wiring, connections, and installation of remote control switches and interfaces for electrically operated projection screens.
2. Division 27 41 16 Integrated Audio Video Systems and Equipment

1.04 QUALITY ASSURANCE

A. The work of this section shall be performed by a company, which specializes in the installation of projection screens as required for this Project with a minimum of 5 years of documented successful experience and shall be performed by skilled workers thoroughly experienced in the necessary crafts.

1. Work shall be performed in compliance with Owner's insurance underwriters' requirements.

B. Manufacturer shall specialize in manufacturing the type of specified projection screen described in this section, with a minimum of 10 years of documented successful experience and have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty for each type of projection screen.

1. Obtain all projection screens from one source from a single manufacturer.
2. Obtain each screen as a complete unit, including necessary mounting hardware, low voltage control interfaces, switches, and accessories.

C. Manufacturer’s identification tags or marks are not acceptable on surfaces that will remain exposed to view after installation.

1. Evidence of “patching” after removal of tags or marks is not acceptable.

D. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrated through, ceilings, including light fixtures, HVAC equipment, fire suppression system, and partitions.

1.05 SUBMITTALS

A. Submit the following according to Conditions of the Construction Contract and Division 1 Specification Sections:

B. Product Data: Shall be clearly marked to indicate all technical information that specifies full compliance with requirements of this section and Contract Documents, including manufacturer's published installation recommendations for each type and size of projection screen required.

C. Shop Drawings: Shall clearly indicate but not be limited to:

1. Location of screen centerline relative to ends of screen case.
2. Location of wiring connections.
3. Connections to suspension systems for screens mounted in recessed surfaces (e.g., ceilings).
4. Anchorage details.
5. Details of juncture of exposed surfaces with adjacent finishes.
6. Frame details.
7. Accessories.
8. Wiring diagrams for electrically operated units.

D. Maintenance Data: Shall clearly describe cleaning methods, cleaning solutions recommended and stain removal methods.

E. Hazardous Materials Notification: In the event no product or material is available that does not contain asbestos, PCB or other hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

F. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB),

1.06 DELIVERY, HANDLING, STORAGE

A. Do not deliver projection screens until building is enclosed.

B. Protect screen surfaces from damage during installation from abrasion, dust and other conditions.

1.07 WARRANTY

A. Comply with General Conditions and Product Requirements, agreeing to repair or replace specified materials or Work that has failed within the warranty period.

1.08 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB), or other hazardous materials identified by the Owner.

1.09 ACCEPTABLE MANUFACTURER

A. General: For the purpose of establishing the minimum functional, aesthetic and quality standards required for work of this section, products of the following manufacturers are specified:

B. Note: Modify this section per project

1. Da-Lite Screen Company, Inc., Warsaw, IN (219) 267-8101

C. Substitutions: Comply with General Conditions using Substitution Request Form.

PART 2 - PRODUCTS

2.01 MANUALLY OPERATED PROJECTION SCREENS (AS PER PROJECT REQUIREMENTS)

A. General: Manufacturer's standard spring-roller-operated units, consisting of case, screen, mounting accessories, and other components necessary for a complete installation.

B. Recessed Ceiling, Metal-Encased, Manually Operated Screens: Units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Da-Lite Screen Company; Advantage Manual with CSR (Ceiling Recessed).

C. Surface mounted from ceiling, mounted at a diagonal, Metal-Encased, Manually Operated Screens: Units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Da-Lite Screen Company; Model C with CSR.

2.02 FRONT-PROJECTION SCREEN MATERIAL

A. Matte-White Viewing Surface: Peak gain not less than 1.0, with half Angle 60 degrees from the axis of the screen surface.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Da-Lite Screen Company; Matte White.

B. Seamless Construction: Provide screens, in sizes indicated, without seams.

C. Edge Treatment: Without black masking borders.

D. Size of Viewing Surface:

1. 60”H x 96”W per Campus Standards

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install projection screens at locations indicated to comply with the manufacturers written instructions.

B. Install front projection screens with screen cases in position and in relationship to adjoining construction as indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when the screen is in the lowered position.

C. Test electrically operated units to verify that the screen, controls limit switches, closure, and other operating components are in optimum functioning condition and that the screens meet all manufacturer's published performance specifications.

3.02 CLEANING AND PROTECTION

A. Protect projection screens after installation from damage during ongoing construction activity. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 115313

LABORATORY FUME HOODS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Benchtop Chemical Fume Hoods
2. Fume hood Base and Special Cabinets

B. Related Sections:

1. Section 123553.19: Laboratory Casework and Furnishings.
2. Division 22: Furnishing and installation of plumbing utilities and final connections to fume hoods.
3. Division 23: Furnishing and installation of exhaust duct work and equipment, and final connection of fume hoods.
4. Division 23: Furnishing and installation of exhaust controls and final connections to hoods.
5. Division 26: Furnishing and installation of electrical utilities and final connections to fume hoods.

1.02 DESIGN REQUIREMENTS

A. Fume hoods shall function as ventilated, enclosed work spaces, designed to capture and confine exhaust fumes, vapors and particulate matter produced or generated within the enclosure.

B. Design fume hoods for consistent and safe air flow through the hood face. Negative variations of face velocity shall not exceed 10 percent of the average face velocity at any designated measuring point as defined in this section.

C. Average illumination of work area: Minimum 80 foot-candles Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 28 inches.

D. Fume hood shall be designed to minimize static pressure loss with adequate slot area and bell shaped exhaust collar configuration.

E. Fume hoods shall be constructed in such a manner as to cause no perceptible increase in sound pressure level over the mechanical exhaust system.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's data for each type of hood specified. Include component dimensions, configurations, construction details, joint details, and attachments. Indicate location, size, and service requirement for each utility connection.

B. Shop Drawings:

1. Submit shop and fabrication drawings stamped by a licensed California Professional Engineer for the laboratory Fume Hoods. This engineer shall perform and submit structural calculations to document the Fume Hoods and proper anchorage to building components.
2. Provide 3/4 inch = 1'-0” scale elevations of individual and battery of hoods showing cross sections, rough-in and anchor placements, tolerances, and clearances. Indicate relation to other laboratory equipment, surrounding walls, windows, doors, and other building components.
3. Provide 1/4 inch = 1'-0" rough-in plan drawings for coordination with trades.
4. Provide 1 set of sepia reproducible prints and 1 set of blueline prints.

C. Top Samples: Submit product sample of each type of benchtop.

D. Finish Samples: Submit 3 inch by 5 inch samples of color of finish for fume hoods, work surfaces and for other prefinished equipment and accessories for selection by the Architect.

E. Test Reports: Submit test reports verifying conformance to specified performance tests.

F. Life Cycle Tests: Provide independent test data for sash hardware components such as cables and pulleys.

G. Maintenance Manuals: Provide written instruction manuals outlining operating and safety instructions and proper maintenance procedures.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Fume hoods, casework, work surfaces, laboratory furnishings, and accessories shall be furnished by a single laboratory furniture company.

B. Manufacturer's Qualifications: Modern plant with proper tools, dies, fixtures, and skilled production staff to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:

1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
2. Ten installations of equal or larger size and requirements.

C. Installer's Qualifications: Factory trained and certified by the manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Schedule delivery of fume hoods and equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.

B. Handling: Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating. Protect all work surfaces throughout construction period with 1/4 inch corrugated cardboard completely covering the top and securely taped to edges.

1.06 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Building areas requiring the installation of laboratory casework shall be dry and unexposed to adverse weather conditions which may damage finished materials.
2. Interior building temperatures shall not register below 65 degrees Fahrenheit in areas of casework installation to permit the proper curing of epoxy sealants and adhesives.

1.07 SEQUENCING AND SCHEDULING

A. All overhead mechanical, electrical and plumbing rough-in work shall be complete prior to laboratory casework deliveries.

B. All mechanical, electrical and plumbing rough-in work required along walls and service islands, where lab furnishings are to be installed, is to be complete prior to delivery of materials.

C. Walls and partitions must be in place and finished with at least the primer coat of paint. If finish painting is to take place after lab furnishings, installation, protect the casework and furnishings by covering and masking prior to commencement.

D. All necessary wood or metal blocking must be installed within partitions prior to delivery of casework and furnishings.

E. Overhead soffits and ceiling grid must be in place prior to casework installation.

F. Overhead lighting must be installed and connected prior to casework installation.

G. All flooring required to be placed under lab casework and furnishings must be installed prior to material delivery.

H. Concrete floors must be level within 1/8 inch of level per 10 foot run, nonaccumulative, when tested with a straight edge in any one direction.

I. Wet operations to be performed must be complete prior to material deliveries.

PART 2 WARRANTY

2.01 WARRANTY

A. Provide a 1-year warranty against defects in materials and workmanship.

PART 3 PRODUCTS

3.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:

1. Kewaunee Scientific Corporation
   Laboratory Division
   P.O. Box 1842
   Statesville, North Carolina 28687
   (704) 873-7202

2. Mott Manufacturing Limited
   452 Hardy Road – N3T 5L8
   P.O. 1120
   Brantford, ON, Canada N3t 5T3
   (519) 752-7825

3. CIF Lab Solutions
   53 Courtland Avenue
   Vaughan, ON, Canada L4K3TZ
   (905) 738-5821

4. Or Approved Equal

B. Casework, furnishings and equipment specified in the following sections shall be furnished and installed by the same supplier:

1. Section 123553.19: Laboratory Casework and Furnishings

3.02 MATERIALS

A. Sheet Steel:

1. Metallic Furniture Stock: ASTM A-1008 mild steel, cold rolled, pickled, double annealed, and free from rust, scales, scratches, buckles, ragged edges, and other defects.
2. Minimum Gages:

a. All gages indicated shall be US Standard.
b. 18 gage thick exterior casing, ceiling closure panels, and bottom sash rail.

B. Stainless Steel:

1. Type 304: ASTM A240; 16 gage exposed surfaces ground and polished to a Number 4 finish.
2. Type 316: ASTM A240; 16 gage; exposed surfaces ground and polished to a Number 4 finish.
3. Welding: All stainless steel welding material shall be of type similar to sheet material. Welds shall be made without discoloration; ground, polished, and passivated to blend harmoniously with a Number 4 satin finish.

C. Epoxy Resin Sheets:

1. Molded from modified epoxy resin that has been especially compounded and cured to provide optimum physical and chemical resistance required of a heavy duty laboratory working surface. Uniform mixture throughout, not dependent on a surface coating.

2. Physical Properties:

a. Compressive Strength (ASTM D695): 30,600 psi.
b. Flexural Strength (ASTM D790): 12,800 psi.
c. Tensile Strength (ASTM D638): 10,100 psi).
d. Heat Distortion (ASTM D648): 330 degrees Fahrenheit
e. Water Absorption (ASTM D570): 0.018 percent.
f. Fire Resistance (ASTM D635): Self Extinguishing.

D. Glass: 7/32 inch clear laminated safety glass.

3.03 BENCHTOP CHEMICAL FUME HOODS

A. Superstructure:

1. Wall: Rigid, self-supporting assembly of double wall construction, maximum 5 inches thick. Double wall shall consist of a sheet steel outer shell and a corrosion resistant inner liner and shall house and conceal steel framing members, attaching brackets and remote operating service fixture mechanisms and services. Hoods shall be completely factory assembled to form a rigid, self-supporting structure.
2. Face Opening: Air foil or streamlined shape with all right angle corners radiuses or angled.
3. Exterior Bypass Grille: Low resistance type, 18 gage steel, upward directional louvers.
4. Interior Bypass:

a. Provide an interior bypass plate on all variable volume or constant volume hoods with combination sashes and on all variable volume hoods with a vertical rising sash.

b. The bypass area: 14 inch high opening on all constant volume hoods with a vertical rising sash.
c. Bypass plate: Manufactures standard material with 1 inch minimum continuous slot at sash header. Provide steel plates with a urethane powder coat finish to match color of hood liner.

5. Ceiling Enclosure Panel: Minimum 18 gage thick, finish to match hood. Provide with hinged panel for access to hood lights, piping and exhaust duct connections.
6. Fastenings:

a. Exterior structural members' attachments: Sheet metal screws, zinc plated.
b. Interior fastening devices concealed. Exposed screws not acceptable.
c. Exterior panel member fastening devices concealed. Exposed screws not acceptable.

B. Sill:

1. Flush sill: Lower front assembly shall consist of a trough with hinged louvered horizontal panels forming a flush sill.

a. Trough to be 16 gage thick, Type 304 stainless steel with an acid and abrasion resistant paint coating applied by an electrodeposition process. Provide 1 inch square 1/16 inch thick rail secured to fume hood end panels for reinforcement. Finish same as trough.
b. Slotted angle horizontal panels, 16 gage thick stainless steel, Type 304, with linear polyurethane finish. Spot weld stand-offs to reinforcement rail and bolt at each end of horizontal panel to stand-offs.
c. Panel slot patterns and size as follows:
   1) 48 inch wide fume hood: (2) 19 inch long panels
   2) 72 inch wide fume hood: (2) 31 inch long panels.
   3) 96 inch wide fume hood: (3) 28-1/2 inch long panels.
d. Color selection of finishes by Architect.
e. Provide chemical resistant sealant along edge of work surface that abuts sill.

C. Sash:

1. Full view type with clear, unobstructed, side to side view of fume hood interior and service fixture connections. Vertical rising. Refer to Fume Hood Schedule for type of sash at each fume hood.
2. Vertical rising sash: 2 inches maximum height bottom sash rail, 18 gage thick steel with a polyurethane powder coat finish. Provide integral formed flush pull the full width of bottom rail. Set safety glass into rails in deep form, extruded polyvinyl chloride glazing channels. Open and close sash against rubber bumper stops.
3. Sash operation: Counterbalanced cable and pulley arrangement or counterbalanced chain and sprocket system. Provide sash stops at 18 inch opening.
4. Sash glass: 7/32 inch thick laminated safety glass.
5. Sash guides: Corrosion resistant polyvinyl chloride.

6. Sash pull: Steel with chemical resistant powder coating. Color selection by the Architect.

D. Liners:

1. Polyester liner: Reinforced glass polyester panel; smooth finish and white color in final appearance. Flexural strength: 21,000 psi. Flame spread: 25 or less per UL 723 and ASTM E84-80. Manufactured by WS Hampshire Inc. "Wesliner 1125". Provide gasketed access panels in the liner for access to valves and fixtures. Panels shall be of the same material as the liner and be provided with a PVC gasket to eliminate air leakage and retain liquids inside the hood.

E. Baffles:

1. Provide baffles to control air vectors into and through the fume hood. Fabricate of the same material as the liner. All baffle supports/brackets to be nonmetallic.
2. Baffle designs which permit close off of all slots are not acceptable.
3. Must comply with OSHA Lab Standard Guidelines.
4. Provide acid resistant label indicating proper baffle operation. Locate label on sidewall of hood interior.
5. Provide for baffle adjustment to allow repositioning prior to hood operation permitting setting for (1) high thermal loading, (2) heavier than air gases or fumes generated near work surface, and (3) normal or average operation.

F. Work Surfaces:

1. Molded epoxy resin or Solid Phenolic resin: For hoods with Poly resin liners. Color to be selected by the Architect from the manufacturers' standard black, gray or white colors. Work surface as manufactured by Durcon Laboratory Tops; Epoxyn Products; Trespa or, equal. 1-1/4 inches thick surface, dished 1/4 inches to contain spills.

G. Sinks

1. Were indicated on the drawings provide the Following Types as Specified in Section11602 Unless Modified under This Sub Paragraph.

   a. Epoxy Resin Lab Sinks:
   b. Epoxy Resin Cupsinks:

H. Lighting:

1. Fixture: 2 lamp, rapid start, UL listed fluorescent light fixture with sound rated ballast installed on exterior of fume hood roof. Provide safety glass panel cemented and sealed to the hood roof.
2. Interior of fixture: White, high reflecting plastic enamel.
3. Size: Largest possible up to 48 inches for hoods with superstructures up to 6 feet. Provide (2) 36 inch fixtures for hoods with (8 foot) superstructures.
4. Include lamps with fixtures.
5. Illumination: 80 foot-candle minimum.

6. Lamps and ballast to be the same type as specified in Division 16 for overhead lighting in laboratory spaces.
7. Light Switch: Gray in color with stainless steel flush face plates.

I. Electrical Power:

1. Three wire grounding type receptacles, as indicated on the Drawings, rated at 120 VAC at 20 amperes.
2. Receptacles: Gray in color with stainless steel flush face plates.
3. Factory installs receptacles, lighting, electrical fixtures and wiring in accordance with applicable codes and Division 16 specifications.
4. Provide a dedicated receptacle on top of hood for safety monitor and alarms.

J. Service Fixtures and Piping:

1. None required, on fume hoods with pre-punched service fixture holes, provide metal or plastic plugs in color to match fume hood, for all unused holes.

K. Exhaust Outlet:

1. Rectangular or round collar; 18 gage thick steel; epoxy powder coated.
2. For hoods with rectangular duct collars, provide exhaust duct transition from the hood rectangular exhaust collar to the building exhaust system round duct connection. Round duct size as indicated in the Fume Hood Schedule. Fabricate transition of the same material as the exhaust outlet. Epoxy powder coat inside and outside.

L. Safety Monitor/Alarm System:

1. Each fume hood shall be equipped with a velocity control and safety alarm unit which is to be provided under Division 23. Provide factory cut outs in the front of the hood for field mounting of the unit. Coordinate location and size of cut out with Division 23. Connection of control and safety alarm unit to sensors and control valves shall be under Division 23.

M. Instruction Plate:

1. Permanent 4 inch by 6 inch plate attached to fume hood exterior with condensed information covering recommended locations for apparatus and accessories, baffle settings, use of sash, and recommended safe operating procedures.
2. Provide a 4 inch by 6 inch corrosion resistant metal or plastic frame attached to front face of fume hood exterior with plastic or glass glazing to contain a removable data card to identify hood and show hood characteristics and field test data.

3.04 FUME HOOD BASE AND SPECIAL CABINETS

A. Under counter Ventilated Cabinets

1. Construction: Construct as specified for Undercounter Flammable Storage Cabinets unless otherwise specified herein.

2. Ventilation: Provide a 2 inch polypropylene vent pipe at the outside rear of the cabinet with 2 inlets, 1 high and 1 low. Extend vent pipe to 4 inches above the hood work surface.
3. Liner: Provide cabinet with ChemCor thermoplastic coating on all interior surfaces as provided on the Justrite Centura line.
4. Bottom: Provide with 1/4 inch thick heat welded, polypropylene or ABS plastic pan, liquid tight, removable, 1 inch deep.
5. Exposed Hardware: Stainless Steel.
6. Finish: Color selected by Architect.
7. Identification: All under counter ventilated cabinets shall be marked with conspicuous lettering: CAUTION - ACIDS/CORROSIVES.

B. Under counter Flammable Storage Cabinets

1. Design: Cabinets shall be designed and constructed in accordance with OSHA Regulations and the requirements of NFPA 30, National Fire Protection Association, Flammable and Combustible Liquids Code. Provide cabinets Factory Mutual (FM) approved or Underwriters Laboratories (UL) listed. Cabinets shall limit the internal temperature at the center 1 inch from the top to not more than 325 degrees Fahrenheit when subjected to the fire test for storage cabinets as described in NFPA 30.
2. Casing: Bottom, top, back, door, and sides of cabinet shall be at least 18 gage sheets steel, double walled with 1-1/2 inch air space. Joints shall be welded airtight. Provide with adjustable zinc plated leveling legs.
3. Door: Provide with continuous piano hinge and a 3-point latching arrangement with door sill raised at least 2 inches above the bottom of the cabinet to retain spilled liquid within the cabinet. When more than 1 door is used, there shall be a rabbetted overlap of not less than 1 inch. Provide self closing self latching door(s) with fusible link(s) to hold doors wide open and melt at 165 degrees Fahrenheit for automatic closure.
4. Vent cabinets to building supply and exhaust systems as indicated on the Drawings, with 2 inch Schedule 40 steel piping. Provide flash arrestors at supply and exhaust connections to cabinet.
5. Shelving: Provide each cabinet with a full width adjustable shelf.
6. Grounding: Ground each cabinet.
7. Identification: All flammable storage cabinets shall be marked with conspicuous lettering: FLAMMABLE - KEEP FIRE AWAY.
8. Finish: Color selected by Architect.

C. Sink and Storage Base Cabinets:

1. End Panels and Backs

    a. 18 gage steel.
    b. End panels and back formed from a single steel sheet with front edges formed to a channel shape and further offset to form a strike for doors and drawers.
    c. Reinforce at front and rear corners with 18 gage full upright posts containing shelf adjustment holes, maximum 1/2 inch on centers.
    d. All sink cabinets to have partial height back panels to allow passage of drain line and piping to service chase.

2. Bottoms:

   a. 18 gage steel.
   b. Bottom and bottom rail formed from a single piece of metal with both sides and back formed up with a radius between flange and bottom for ease of cleaning. Form front rail to provide a strike for doors and drawers.
   c. Reinforce at front corners with 14 gage gusset.

3. Front Top Rails:

   a. 16 gage steel.
   b. Provide flush at face of cabinet and interlock within the flange at the top of the end panels. Form front of rail to provide a strike for doors and drawers.
   c. Reinforce at front corners with 14 gage gusset.

4. Toe space Rails:

   a. 18 gage steel.
   b. Install between end panels to provide a minimum toespace of 3 inches deep by 4 inches high.
   c. Provide 11 gage steel corner gussets at front and rear corners with 3/8 inch diameter leveling screws integral with bottom flange.

5. Adjustable Pullout Shelves:

   a. 20 gage steel.
   b. Form in one-piece including the bottom, two sides, front, and back.
   c. Sides, front, and back to be 2 inches high with return bends to eliminate sharp edges.
   d. Adjustable on 1/2 inch centers.
   e. Front edge of shelf to be within 1 inch of inside face of door.

6. Hinged Doors:

   a. 3/4 inch double wall assembly with 18 gage exterior panel and 20 gage interior panel.
   b. Reinforce interior of front panel with welded steel hat channels. Pre paint and sound deaden interior. Weld outer corners and grind smooth.
   c. Secure hinges with screws to internal 14 gage reinforcing in case and door. Hinges shall be removable; welding of hinges is not acceptable.
   d. Doors shall close against rubber bumpers.

3.05 METAL FINISH FOR FUME HOOD, AND FUME HOOD BASE AND SPECIAL CABINETS

A. Provide as specified for Metal Finish in Section 123553.19.

3.06 SOURCE QUALITY CONTROL TESTING OF EPOXY RESIN WORK SURFACE

A. As specified for Source Quality Control Testing of Epoxy Resin Work Surface in Section123553.19.

3.07 SOURCE QUALITY CONTROL TESTING OF POLY RESIN LINER

A. Test Procedure:

1. Test Number 1 - Spills and Splashes:

   a. Suspend in a vertical plane a 42 inch (horizontal) by 12 inch (vertical) panel divided into 3/4 inch wide vertical columns.
   b. Apply 5 drops of each reagent listed with an eye dropper.
   c. Apply liquid reagents at top of panel and allow to flow down full panel height. (CAUTION! Flush away any reagent drops.)

2. Test Number 2 - Fumes and Gases:

   a. Divide 24 inch by 12 inch) panel into 2 inch) squares.
   b. Place 25 milliliters of reagent into 100 milliliter beakers and position panel over beaker tops in the proper sequence. Note: Beaker pouring lip permits atmospheric oxygen to enter and participate in the reaction of the reagent fumes.

3. After 24 hours remove panel, flush with water, clean with naphtha and detergent, rinse, wipe dry and evaluate.

B. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:

1. No Effect: No detectable change in surface material.
2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

C. Test Results: Submit a report of the test results. The results shall be equal to or better than the following:

	Reagent List Concentrations by Weight	Test 1 Rating Spills	Test 2 Fumes
1.	Sodium Hydroxide Flake	No Effect	No Effect
2.	Sodium Hydroxide, 40 percent	No Effect	No Effect
3.	Sodium Hydroxide, 20 percent	No Effect	No Effect
4.	Sodium Hydroxide, 10 percent	No Effect	No Effect
5.	Ammonium Hydroxide, 28 percent	No Effect	No Effect
6.	Methylene Chloride	No Effect	No Effect

7.	Chloroform	No Effect	No Effect
8.	Carbon Tetrachloride	No Effect	No Effect
9.	Monochlorobenzene	No Effect	No Effect
10.	Tincture of Iodine	No Effect	Good
11.	Methyl Alcohol	No Effect	No Effect
12.	Ethyl Alcohol	No Effect	No Effect
13.	Butyl Alcohol	No Effect	No Effect
14.	Phenol, 85 percent	No Effect	Excellent
15.	Cresol	No Effect	No Effect
16.	Sodium Sulfide	No Effect	No Effect
17.	Furfural	Excellent	Excellent
18.	Dioxane	No Effect	No Effect
19.	Zinc Chloride	No Effect	Excellent
20.	Benzene	No Effect	No Effect
21.	Toluene	No Effect	No Effect
22.	Xylene	No Effect	No Effect
23.	Gasoline	No Effect	No Effect
24.	Naphthalene	No Effect	No Effect
25.	Methylethyl Ketone	No Effect	No Effect
26.	Acetone	No Effect	No Effect
27.	Ethyl Acetate	No Effect	No Effect
28.	Amyl Acetate	No Effect	No Effect
29.	Ethyl Ether	No Effect	No Effect
30.	Silver Nitrate, 10 percent	Excellent	Excellent
31.	Dimethylformamide	Excellent	Excellent
32.	Formaldehyde, 37 percent	No Effect	No Effect
33.	Formic Acid, 88 percent	No Effect	Excellent
34.	Acetic Acid, Glacial	No Effect	No Effect
35.	Dichloroacetic Acid	No Effect	Excellent
36.	Chromic Acid, 60 percent	No Effect	No Effect
37.	Phosphoric Acid, 85 percent	No Effect	No Effect
38.	Sulfuric Acid, 33 percent	No Effect	Excellent
39.	Sulfuric Acid, 77 percent	No Effect	No Effect
40.	Sulfuric Acid, 93 percent	No Effect	No Effect
41.	Hydrogen Peroxide, 30 percent	No Effect	No Effect
42.	Acid Dichromate	No Effect	No Effect
43.	Nitric Acid, 20 percent	No Effect	Excellent
44.	Nitric Acid, 30 percent	No Effect	No Effect
45.	40 & 47 Equal Parts	No Effect	Good
46.	Nitric Acid, 70 percent	No Effect	Good
47.	Hydrofluoric Acid, 48 percent	No Effect	Excellent
48.	Hydrochloric Acid, 37 percent	No Effect	Excellent

3.08 SOURCE QUALITY CONTROL TESTING OF FUME HOODS

A. Test one fume hood of each type and size specified in accordance with the method prescribed in American National Standard ANSI/ASHRAE 110-1995 or latest edition. The minimum overall performance rating of each test shall be 4.0 AM 0.05 with 4.0 the tracer gas release rate in liters per minute, AM identifying an "as manufactured" test, and 0.05 indicating the maximum level of tracer gas, in parts per million, in the breathing zone.

B. Hood test shall take place in the manufacturer's test facility with testing personnel, samples, apparatus, instruments, and test materials supplied by the manufacturer.

3.09 SOURCE TESTING OF FUME HOOD SOUND LEVELS

A. Provide the following historic certified sound test data for each size and type of fume hood:

1. Background sound pressure level readings for the test facility with exhaust system operating but without connection to the fume hood.
2. A second set of readings recorded with the fume hood connected and operating and the sensor located 36 inches in front of the sash assembly.
3. Certified report: Octave band sound pressure level, Db re 20 micro Pa in the 31.5 to 8,000 Hertz frequency range, for the fume hood operating.

PART 4 EXECUTION

4.01 INSTALLATION

A. Installation:

1. Install fume hoods and equipment in accordance with manufacturer's instructions.
2. Install equipment plumb, square, and straight with no distortion and securely anchored as required.
3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

B. Accessory installation: Install accessories and fixtures in accordance with manufacturer's recommendations.

4.02 FIELD QUALITY CONTROL TESTING OF FUME HOODS

A. Testing Requirements

1. Each fume hood shall be commissioned in accordance with the test procedures prescribed in American National Standard ANSI/ASHRAE 110-2016 or latest edition.
2. The fume hood commissioning agent shall be a third party and not a representative of the manufacturer or installation contractor.
3. Provide the Owner's Representative two weeks prior notice of the testing start date.

B. Testing Conditions

1. Conduct tests under conditions as specified under Paragraph 5.1.1 of ANSI/ASHRAE 110 latest edition.

2. Commence fume hood commissioning immediately after the final Test and Balance Report has been approved and before the Owner has occupied the laboratory.
3. Verify that the building makeup air system is in operation, the doors and windows are in normal operating position, and that all other hoods and exhaust devices are operating at design conditions.
4. Correct any unsafe conditions disclosed by these tests before request of test procedures.

C. Instrumentation and Equipment

1. Employment instrumentation and equipment as specified under Article 4 of ANSI/ASHRAE 110 latest edition.

D. Flow Visualization Test

1. Conduct both Local Visualization and Large Volume Visualization Tests in accordance with ANSI/ASHRAE 110 latest edition, Article 6.1 or latest edition.
2. If there is visible smoke flow out of the front of the hood, the hood fails the test.

E. Face Velocity Test

1. Provide face velocity measurements as outlined in Articles 6.2, 6.3 and 6.4 of ANSI/ASHRAE 110-1995 or latest edition.

F. Tracer Gas Test

1. Provide a tracer gas test for each fume hood in accordance with the procedures specified under Article 7 of ANSI/ASHRAE 110 latest edition.
2. Hoods shall achieve a rating of 4.0 AI 0.10, with 4.0 being the tracer gas release rate in liters per minute, AI identifying an "as installed" test, and 0.10 indicating the maximum level of tracer gas, in parts per million, in the breathing zone.

G. Test Reports

1. Provide a test report for each test for each hood. Report shall include a record of all measurements and an indication of test "pass" or "failure".
2. Submit six (6) copies of the test repot for approval.

4.03 ADJUSTING

A. Repair or remove and replace defective work, as directed by the Owner's Representative upon completion of installation.

B. Adjust sash, fixtures, accessories and other moving or operating parts to function smoothly.

4.04 CLEANING

A. Clean equipment, touch up as required.

4.05 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.

B. Advise Contractor of procedures and precautions for protection of material and installed fume hoods from damage by work of other trades.

END OF SECTION 115313

SECTION 115353

BIOLOGICAL SAFETY CABINETS

PART 1 GENERAL

1.1 Summary

A. Section Includes:
1. Biological Safety Cabinets (Class II, Type A2)

1.2 References

A. National Institutes of Health (NIH), Specification NIH 03-112C.

B. Underwriters Laboratory, Inc. (UL), for electrical safety and integrity.

C. National Sanitation Foundation International Standard/American National Standard NSF/ANSI 49-2002 for Class II Biosafety Cabinetry.

D. Federal Standard 209E.

1.3 Submittals

A. Product Data and Shop Drawings: Submit for each item of equipment specified. Include component dimensions, configurations, construction details, joint details, accessories, seismic anchoring details, and utility requirements.

B. Quality Control Submittals

1. Certified copies of the test report for each Class II biological safety cabinet indicating compliance with Standard NSF/ANSI 49-2002; Section 6, Performance Criteria and Annex A, Performance Tests.
2. Certified copies of the field test report for each biological safety cabinet, performed in accordance with the criteria and procedures set forth in Annex F of Standard NSF/ANSI 49-2002.

C. Manufacturer's operating and maintenance manuals.

1.4 Quality Assurance

A. Single Source Responsibility: Laminar airflow equipment and accessories shall be furnished by a single manufacturer.

B. Manufacturer's Qualifications:

1. Five years or more experience in manufacture of laminar airflow equipment of type specified.
2. Ten installations of equal or larger size and requirements.

C. Installer's Qualifications: Factory trained and/or certified by the manufacturer.

1.5 Delivery, Storage, And Handling

A. Ship units in sections, as required, to allow the largest components to fit through a standard 900 mm by 2040 mm door.

B. Delivery: Schedule delivery of equipment so that spaces are sufficiently complete that equipment can be installed immediately following delivery.

C. Handling: Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.

1.6 Project Conditions

A. Do not deliver or install equipment until the following conditions have been met:

1. Windows and doors are installed, and the building is secure and weathertight.
2. Ceiling, overhead ductwork and lighting are installed.
3. All painting is completed, and floor tile is installed.

1.7 Warranty

A. All equipment furnished under this Section of the Specifications shall be guaranteed, for a period of one year from the date of acceptance thereof, against defective materials, design and workmanship. Equipment Manufacturer's warranties shall be made to the benefit of the Owner.

PART 2 - Products

2.1 General Description

A. Manufacturers

1. The Baker Company
PO Drawer E
Sanford, Maine 04073
(800) 992-2537

2. Nuaire, Inc.
2100 Fernbrook Lane
Plymouth, Minnesota 55441
(800) 328-3352

3. Labconco Corporation
   8811 Prospect Avenue
   Kansas City, Missouri 64132
   (800) 821-5525

B. Size and classification of biological safety cabinets at each location shall be as shown on the Drawings.

2.2 Biological Safety Cabinets (Class II, Type A2)

A. Design

1. Maintain a minimum calculated or measured average air inflow velocity of 0.5 meters per second through the work area access opening.
2. HEPA filtered downflow air from a common recirculation/exhaust plenum (100 percent of air recirculated).
3. Discharge all exhaust air to the atmosphere after HEPA filtration.
4. All biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums.

B. Construction

1. Interior: Minimum 1.6 mm Type 304 stainless steel. Work area shall be provided with radius or rounded corners with side walls and rear wall of one piece construction.
2. Exterior: Construct of at least 1.2 mm sheet steel with surface finished in a baked enamel. Color shall be selected by the Owner's Representative from one of the manufacturer's standard colors.
3. Unit shall have all permanent metal air plenums.
4. Viewscreen: Sliding or hinged and constructed of 6 mm safety glass. The viewscreen shall be capable of being fully closed and of being opened to 480 mm for setups.
5. Cabinet shall have sealed construction, pressure tested on each unit and shall be capable of being easily fumigated employing an established procedure recommended by NIH or NSF.
6. Provide each unit with an adjustable height stand to allow work surface to be set from 760 to 900 mm above finished floor.

C. Airflow and Filtration

1. Supply and exhaust filters shall be HEPA type and rated 99.99 percent efficient for 0.3-micron particulates by DOP test. Perforated stainless steel screens shall be provided to protect the filters. Both exhaust and supply filters shall be front loading.
2. Unit shall have an 200 mm high front access opening with a calculated intake velocity of 0.5 meters per second.
3. Air balancing: Damper shall be located in the filter housing area to be used when filters are changed to maintain design criteria with varying differences in filter resistance.

D. Controls and Alarms

1. The unit motor/blower shall provide a constant volume of air with increasing resistance caused by filter loading.
2. The unit speed controller shall automatically compensate for voltage change to maintain constant voltage to the motor.
3. Alarms: Equipped with an audible alarm which sounds when the viewscreen is not at its proper operating height.
4. A magnehelic gage shall display the pressure drop over the supply HEPA filter.

E. Electrical

1. Power: Provide a single 3 m, 3 wire cord with a molded plug, suitable for a single 20 amp, 120/60/1 receptacle.
2. Two electrical circuits: 1 for blower/lights and 1 for duplex outlets. Each circuit shall be protected by a circuit breaker located in the instrument panel. Work area shall be provided with 2 GFI duplex outlets, one on each side, with drip proof covers and circuit breakers.
3. Fluorescent lighting: Externally mounted and shall provide 970 lx to 1290 lx on the work surface, inside the cabinet.

F. Accessories

1. Provide piped services on the left or right side of the cabinets, as indicated on the Drawings.
2. Stainless steel ball type drainage valve for safe and effective drainage of the drain pan.
3. Germicidal ultraviolet (UV) light.

G. Selected Options

1. Seismic Restraints

2.3 Source Quality Control Testing - Biological Safety Cabinets

A. Tests

1. Factory test each Class II biological safety cabinet in accordance with the requirements of Standard NSF/ANSI 49-2002; Section 6, Performance Criteria and Annex A, Performance Tests.
2. Submit certified copies of all test reports.
3. A representative of the Owner may elect to witness the performance tests. Notify the Owner 10 days in advance of any tests.

PART 3 - Execution

3.1 Installation

A. Install biological safety cabinets in strict accordance with the manufacturer's recommendations.

B. Provide and install each cabinet with a seismic tie-down kit.

C. Set adjustable height stand to allow work surface to be 760 mm above finished floor unless otherwise noted on the drawings.

3.2 Supervision and Startup

A. Provide the services of the manufacturer's factory trained field representative to inspect and provide written approval of the installation.

B. Include the services of the manufacturer's representative to start up and test the equipment, and to instruct the Owner's operating personnel in the proper care and operation of the units.

3.3 Biological Safety Cabinet Field Tests

A. Field test each Class II biological safety cabinet in accordance with the methods and acceptance criteria described in Annex F of Standard NSF/ANSI 49-2002.

B. Perform the following tests on site:

1. Downflow velocity profile test
2. Inflow velocity profile test
3. Airflow smoke patterns
4. HEPA filter leak test
5. Cabinet leak test
6. Electrical leakage, ground circuit resistance, and polarity tests
7. Lighting intensity test
8. Vibration test
9. Noise test

C. Submit certified copies of all test reports.

END OF SECTION 115353

SECTION 12 24 13

ROLLER WINDOW SHADES

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.

1.02 SUMMARY

A. Section Includes: Manually operated roller shades with double rollers.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 07 92 00 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

D. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.06 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

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. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.02 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS

A. Basis of Design Product: Design is based on product manufactured by MechoShade Systems, Inc. Provide product indicated in “Materials and Finish Schedule” or equal.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, jamb mounted.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Double-Roller Mounting Configuration: Offset, outside roller over and inside roller under.
2. Inside Roller:

a. Drive-End Location: Right side of interior face of shade.
b. Direction of Shadeband Roll: Reverse, from front (interior face) of roller.

3. Outside Roller:

a. Drive-End Location: Right side of interior face of shade Left side of interior face of shade As indicated on Drawings Insert requirements.
b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

4. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

E. Inside Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As indicated in “Materials and Finish Schedule” on Drawings, or equal .

F. Outside Shadebands:

1. Shadeband Material: Light-blocking fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As indicated in “Materials and Finish Schedule” on Drawings, or equal.

G. Installation Accessories:

1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.
b. Provide pocket with lip at lower edge to support acoustical ceiling panel.

2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners. Closure-Panel Width: As indicated on Drawings.
3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
4. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
5. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.03 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Weave: Basketweave.
3. Orientation on Shadeband: Up the bolt.
4. Openness Factor: As indicated on Drawings.
5. Color: As indicated on Drawings.

A. Light-blocking Shadebands:

1. Shadeband Material: Light-blocking fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Source: Roller shade manufacturer.
b. Type: Enclosed in sealed pocket of shadeband material.
c. Orientation on Shadeband: Up the bolt.
d. Color and Finish: As indicated in “Materials and Finish Schedule” on Drawings, or equal.

2.04 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F: Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances,and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

B. Roller Shade Locations: As indicated on Drawings.

3.03 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.04 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION

SECTION 123553.19

LABORATORY CASEWORK AND FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood laboratory casework

B. Special cabinets

C. Tables

D. Work surfaces

E. Sinks

F. Service fixtures

G. Shelving

H. Accessory equipment

1.02 RELATED SECTIONS

A. Section 115313: Laboratory Fume Hoods.

B. Division 22: Furnishing and installation of plumbing utilities and final connections to service fixtures.

C. Division 23: Furnishing and installation of exhaust ductwork and equipment, and final connection to exhaust devices.

D. Division 26: Furnishing and installation of electrical utilities and final connections to casework and accessory equipment.

1.03 REFERENCES (CURRENT EDITIONS)

A. Americans with Disabilities Act (ADA)

B. American National Standards Institute (ANSI)

1. ANSI A208.1 - For Particleboard.
2. ANSI A208.2 - For Medium Density Fiberboard.

3. ANSI Z358.1 - Emergency Eyewash and Shower Equipment
4. ANSI/HPVA HP-1 - For Hardwood and Decorative Plywood.

C. American Society for Testing and Materials (ASTM)

1. ASTM A240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for pressure Vessels and General Applications.
2. ASTM A366 - Withdrawn, Replaced by ASTM A1008.
3. ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
4. ASTM D570 - Water Absorption of Plastics.
5. ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Plastics in Horizontal Position.
6. ASTM D638 - Tensile Properties of Plastic.
7. ASTM D648 - Deflection Temperature of Plastic under Flexural Load in the Edgewise Position.
8. ASTM D695 - Compressive Properties of Rigid Plastics
9. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D. American National Standard for Cabinet Hardware BHMA A156.9

E. American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association BHMA A156.9

F. Architectural Woodwork Standards (AWS) AWI/AWMAC/WI

G. Business and Institutional Furniture Manufacturers Association (BIFMA)

H. Factory Mutual (FM)

I. Forest Stewardship Council (FSC)

J. High – Pressure Decorative Laminates NEMA LD 3

K. National Electrical Manufacturers Association (NEMA)

1. NEMA LD3-2000 - High-Pressure Decorative Laminates.

L. National Fire Protection Association (NFPA)

1. NFPA 30 - Flammable and Combustible Liquids Code

M. North American Architectural Woodwork Standards (NAAWS)

N. Office of Safety and Health Administration (OSHA)

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O. Scientific Equipment and Furniture Association (SEFA)

1. SEFA 8 - Laboratory Furniture Casework, Shelving and Tables Recommended Practices Testing

P. Underwriters Laboratories (UL)

Q. WI (CPP) – Certified Compliance Program (CPP)

R. Woodwork Institute (WI)

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data for each item of laboratory furnishings and equipment. Include component dimensions, configurations, construction details, joint details, and attachments. Indicate location, size, and service requirement for each utility connection.

B. Shop Drawings:

1. Submit shop and fabrication drawings stamped by a licensed California Professional Engineer for the laboratory casework systems. This engineer shall perform and submit structural calculations to document the casework systems and proper anchorage to building components.
2. Provide 3/8 inch = 1 foot 0 inches scale minimum elevations of individual and battery of casework units showing cross sections, rough-in and anchor placements, tolerances, and clearances. Indicate relation of units to fume hoods, other laboratory equipment, surrounding walls, windows, doors, and other building components.
3. Provide 1/4 inch = 1 foot 0 inches rough-in plan drawings for coordination with trades. Rough-in shall show free area.
4. Provide 1 set of reproducible prints.

C. Top Samples: Submit product sample of each type of benchtop.

D. Hardware Samples: Provide samples of door and drawer pulls, locks, and hinges.

E. Finish Samples: Submit 12 inch square samples of each color of finish for casework, work surfaces and for other prefinished equipment and accessories for selection by the Architect.

F. Cabinet Samples: Submit the following full size cabinet samples constructed as specified herein. Ship to the Lab Consultant for review and approval before fabrication of casework and after approval of cabinet hardware and finish sample submittals.

1. Cabinet Types: B301 and B242.

G. Test Reports: Submit test reports verifying conformance to specified performance tests.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility: Provide casework, work surfaces, laboratory furnishings, and accessories, all furnished by a single laboratory furniture company.

B. Manufacturer's Qualifications: Modern plant with proper tools, dies, fixtures, and skilled production staff to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:

1. 5 years or more experience in manufacture of laboratory casework and equipment of type specified.
2. 10 installations of equal or larger size and requirements.

C. Installer's Qualifications: Factory trained and certified by the manufacturer.

D. All casework requires the (WI) certificate of compliance label.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Schedule delivery of casework and equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.

B. Handling: Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating. Protect all work surfaces from damage throughout construction period. Do not allow standing on work surfaces during the construction period. Provide signage marked in large lettering that reads: “NO STANDING”.

1.07 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Building areas requiring the installation of laboratory casework: Dry and unexposed to adverse weather conditions which may damage finished materials.
2. The air conditioning or heating system: On and functioning in areas of casework installation to maintain the temperature between 60 and 85 degrees Fahrenheit with the relative humidity between 45 percent and 65 percent.

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1.08 SEQUENCING AND SCHEDULING

A. All overhead mechanical, electrical and plumbing rough-in work: Complete prior to laboratory casework deliveries.

B. All mechanical, electrical, and plumbing rough-in work required along walls and service islands, where lab furnishings are to be installed: Complete prior to delivery of materials.

C. Walls and partitions must be in place and finished with at least the primer coat of paint. If finish painting is to take place after lab casework and furnishings installation, protect the casework and furnishings by covering and masking prior to commencement.

D. All necessary wood or metal blocking must be installed within partitions prior to delivery of casework and furnishings.

E. Overhead soffits and ceiling grid must be in place prior to casework installation.

F. Overhead lighting must be installed and connected prior to casework installation.

G. All flooring required to be placed under lab casework and furnishings must be installed prior to material delivery.

H. Concrete floors must be level within 1/8 inch of level per 10 foot run, noncumulative, when tested with a straight edge in any one direction.

I. Wet operations to be performed must be complete prior to material deliveries.

1.09 WARRANTY

A. Provide a 1-year warranty against defects in materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:

1. Kewaunee Scientific Corporation
   Laboratory Division
   P.O. Box 1842
   Statesville, North Carolina 28687
   (704) 873-7202

2. Mott Manufacturing Limited
   452 Hardy Road – N3T 5L8
   P.O. 1120
   Brantford, ON, Canada N3t 5T3
   (519) 752-7825

3. CIF Lab Solutions
   53 Courtland Avenue
   Vaughan, ON, Canada L4K3TZ
   (905) 738-5821

4. Or Approved Equal

B. Furnish and install casework, furnishings and equipment specified in the following sections by the same supplier:

1. Section 123553.19: Laboratory Casework and Furnishings
2. Section 115313: Laboratory Fume Hoods

2.02 CASEWORK DESIGN

A. Minimum standards for work within this Section: Construct in accordance with Laboratory Grade of the Woodwork Institute - Manual of Millwork, or Premium Grade of the Architectural Woodwork Institute/AWMAC - Quality Standards, latest editions unless otherwise specified herein.

B. Operable parts for all accessible casework shall comply with CBC Section 11B-309

C. Flush overlay style constructed of Red Oak.

D. Rigid and self-supporting cabinets suitable for use in an assembly or as individual, stand-alone units, with joints securely glued and cabinets clamped under pressure during assembly to ensure secure joints and cabinet squareness.

E. Joints: Doweled and glued or mortised and tenoned secured with glue and countersunk screws.

F. Testing of Casework, Tables, and Shelving: Meet or exceed SEFA 8.

2.03 MATERIALS

A. Wood (Wood fabricated from old growth lumber is not permitted)

1. Definition of cabinet components by surface visibility.

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a. Exposed Surfaces:
   1) All surfaces visible when doors and drawers are closed, including knee spaces.
   2) Visible surfaces in open cabinets or behind clear glass doors.
   3) All exterior surfaces of suspended casework.
   4) Bottoms of cabinets if 42 inches or more above finished floor, including cabinet bottoms behind light valances and the bottom edge of light valances.
   5) Visible cabinet tops up to 78 inches above finished floor or are visible from an upper floor or building level after installation.
   6) Interior faces of hinged doors.
   7) Visible front edges of stretchers, ends, dividers, tops, bottoms, shelves, and hanging stile.
   8) Visible portions of bottoms, tops, and ends in front of sliding doors.
   9) Visible cabinet sloping tops.
   10) Visible portions of cabinets after fixed appliances are installed.

b. Semi-exposed Surfaces:
   1) Shelves.
   2) Dividers.
   3) Interior face of sides, backs, and bottoms on cupboard and drawer units, including cabinet top members 36 inches or more above finished floor.
   4) Drawer sides, sub-fronts, backs, and bottoms.
   5) The underside of cabinet bottoms between 24 inches and 42 inches above finished floor.

c. Concealed Surfaces:
   1) Toe space unless otherwise specified.
   2) Sleepers, stretchers, security panels, and solid sub-tops.
   3) Bottoms of cabinets less than 24 inches above finished floor.
   4) Tops of cabinets over 78 inches above finished floor and not visible from an upper level.
   5) The three non-visible edges of adjustable shelves.

2. Hardwood Lumber:

   a. Type 1 Hardwood: Plain sawn Red Oak Grade FAS, first and seconds or better, well matched for color and grain.
   b. Type 2 Hardwood: Select grade hardwood of a species suitable for the specified purpose.
   c. Provide all lumber clean and free of defects; kiln and air dried to a uniform minimum moisture content of 6 percent.

3. Hardwood Plywood:

   a. In accordance with ANSI/HPVA HP-1-2004 unless otherwise specified herein.
   b. Veneer:
      1) Grade: Middle or higher of A-1with Vertical matched grain direction on cabinet drawer heads, doors, end panels, KO panels, and filler Panels. Horizontal grain direction on cabinet drawer heads.
      2) Color and Matching Selection:
         a) Compatible in color with solid stock and well matched in color and grain with adjacent plywood panels.
         b) Hand select plywood prior to fabrication of cabinet faces for uniformity of color and grain on each run of bench. Darker and lighter panels are not acceptable in the same run of bench or same room after installation of casework.
      3) Species:
         a) Exposed and Semi-Exposed: Red Oak
         b) Concealed: Plain sliced hardwood veneer, suitable for unexposed surfaces
      4) Cut: Plain Sliced, 1/50-inch-thick minimum.
      5) Matching Type: Slip
      6) Matching Arrangement: Running
      7) Cores:
         a) Veneer: One-piece hardwood solid core with crossbanding and hardwood face veneers. Minimum 9 ply for 1 inch, 7 ply for 3/4 inch, 5 ply for 1/2 inch, and 3 ply for 1/4 inch.
         b) Particleboard: Medium density, Grade M-3 particleboard with hardwood face veneers.
         c) MDF: Medium density fiberboard, Grade 130-MR50 with hardwood face veneers.
         d) Combination with Composite Crossbands: Minimum 7 ply for 3/4 inch. One-piece hardwood solid core with two hardwood solid and two MDF crossbands and hardwood face veneers. MDF crossbands under face veneers.
      8) Bond Type: Type II

4. Hardboard:

   a. Tempered hardboard designed for strength and moisture resistance; consisting of wood fibers, highly compressed into a hard,

dense, 1/4-inch thick, homogeneous sheet using natural resins and other added binders.

b. Physical Properties:
   1) Average modulus of rupture: 5300 psi.
   2) Density: 50 to 60 pounds per cubic foot.
   3) Tensile strength: 3,500 psi.

5. Particleboard: Medium density, Grade M-3, average density of 45 to 50 pounds per cubic foot, meeting or exceeding ANSI Standard A208.1.

   a. Physical Properties:
      1) Maximum Average Moisture Content: 10 percent.
      2) Modulus of Rupture: 2393 psi.
      3) Modulus of Elasticity: 398,900 psi.
      4) Internal Bond: 80 psi.
      5) Face Screw Holding Strength: 247 pounds.
      6) Edge Screw Holding Strength: 225 pounds.
      7) Thickness Tolerance: 0.004 inches.

6. Medium Density Fiberboard (MDF): Grade 130-MR50, average density of 45 to 50 pounds per cubic foot, meeting or exceeding ANSI Standard A208.2.

   a. Physical Properties:
      1) Maximum Average Moisture Content: 9 percent.
      2) Modulus of Rupture: 3481 psi.
      3) Modulus of Elasticity: 348,100 psi.
      4) Internal Bond: 87 psi.
      5) Face Screw Holding Strength: 247 pounds.
      6) Edge Screw Holding Strength: 197 pounds.
      7) Thickness Tolerance: 0.005 inches.

7. Edge Grain Red Oak Top: 1-3/4 inch. thick top with edge grain exposed, composed of solid hard maple strips not more than 1-3/4 inch wide, glued with water resistant resin under heavy pressure side to side and end to end. Round top edges and corners and sand smooth. Apply 2 coats of boiled linseed oil, well rubbed into all surfaces.
8. Glue: Type 2 or Type 3 water resistant glue with gluing done in clamps and jigs.
9. Finish: Highly chemical resistant acrylic urethane varnish finish with "blocker" additive to resist fading of finish from sunlight. Stain color selected by the Architect.
10. Dowels: Minimum 3/8-inch diameter hardwood, laterally fluted, chamfered ends.

B. Sheet Steel:

ASTM A1008 mild steel, cold-rolled, pickled, double annealed, and free from rust, scales, deep scratches, buckles, ragged edges, and other defects. Provide metallic furniture stock sheets.

C. Stainless Steel:

1. Type: Unless otherwise noted on Drawings or elsewhere in this Section, provide Type 304; ASTM Specification Number A240; stainless steel for tops, sinks, umbilical collar, shelves, and casework; gage as indicated on Drawings.
2. Finish: Exposed surfaces ground and polished to a Number 4 satin finish. Provide Type 304 with a tumbled finish approximating a Number 4 finish for nuts, screws, bolts, and rivets.
3. Welding: Provide all stainless-steel welding material of type similar to sheet material. Provide welds made without discoloration; ground, polished, and passivated to blend harmoniously with a Number 4 satin finish.

D. Plastic Laminate:

1. Grade VGP: For horizontal surfaces. High pressure decorative laminate, laboratory grade, chemically resistant, meeting or exceeding NEMA Standard LD 3-2000 Grade VGP. Low glare finely ground textured finish with gloss reading of 12.
2. Grade BKL: Backing sheets. High pressure phenolic meeting or exceeding NEMA Standard LD 3-2000, Grade BKL.
3. Core Material: Particleboard.
4. Laminate Adhesives: Bond laminate to core with a liquid polyvinyl acetate or urea resin adhesive at temperatures above 60 degrees Fahrenheit at a pressure no less than 15 pounds per square inch. Laminate and core material; laminated and cured in a controlled environment between 40 percent and 60 percent relative humidity.
5. Edge banding: High grade PVC edging applied, under heat and pressure, by edge banding machine with hot melt waterproof adhesive of same color as edging. Trim and buff smooth with all edges and corners radiused. Color selection from nonstandard colors.

E. Epoxy Resin Sheets:

1. Molded from modified epoxy resin that has been compounded and cured to provide optimum physical and chemical resistance required of a heavy-duty laboratory working surface. Uniform mixture throughout, not dependent on a surface coating.
2. Physical Properties:
   a. Compressive Strength (ASTM D695): 30,600 psi.
   b. Flexural Strength (ASTM D790): 12,800 psi.
   c. Tensile Strength (ASTM D638): 10,100 psi.
   d. Heat Distortion (ASTM D648): 330 degrees Fahrenheit.

e. Water Absorption (ASTM D570): 0.018 percent.
f. Fire Resistance (ASTM D635): Self Extinguishing.

F. Solid Phenolic Resin Sheets:

1. Trespa Toplab Plus Laboratory Tops, FunderMax Max Compact Resistance2.
2. A self-supporting flat panel based on thermosetting resins, homogeneously reinforced with cellulose fibers and manufactured under high pressure. Electron-beam cured decorative surface of pigmented resins.
3. Physical Properties:
   a. Material: Solid phenolic panel.
   b. Modulus of Elasticity: 1,500,000 psi (10,335 MPa) minimum.
   c. Shear Strength: 2,000 psi (14 MPa) minimum.
   d. Compressive Strength: 24,000 psi (165 MPa) minimum
   e. Weight: 93 pef (1,490 kg/m3) maximum.
   f. Fire Performance: Maximum flame spread of 25 per ASTM E84 (Class I, Class A).
   g. Nonporous surface and edges.
   h. Microbial Characteristics: Will not support micro-organic growth.

G. Glass:

1. Laminated safety glass: Two outer plies of glass with a vinyl interlayer, nominal 1/4 inch thick.
2. Tempered safety glass: Heat treated glass, nominal 1/8 inch thick with a minimum of 88 percent clarity.

H. Polycarbonate Resin Sheets: Lexan as manufactured by General Electric Corporation, or Tuffak as manufactured by Rohm and Haas Company, 1920 Tubeway Avenue, Los Angeles, California. 1/4 inch thick unless otherwise noted, clear. Provide sheets free of warp and distortion.

I. Polypropylene: Provide 1/4-inch-thick sheets unless otherwise noted, smooth, free of surface blemishes with all edges rounded to 1/8 inch radius; low flame spread and low smoke generating type.

2.04 CASEWORK FABRICATION

A. Base Cabinets:

1. End Panels:

   a. 3/4-inch veneer core plywood.
   b. Exposed edges: 1/8-inch Type 1 hardwood edge banding.

c. Provide a minimum of 2 rows of drilled holes in each end panel, 1-1/4 inch on centers, for the attachment of drawer and shelf slides or shelf clips.
d. Attach to top frame, bottom, intermediate rails, and toe space rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
e. Attach to top, bottom, and intermediate rails, with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

2. Bottoms:

a. 3/4-inch veneer core plywood.
b. Exposed edges: 1/8-inch, Type 1 edge banding.
c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

3. Top Frames:

a. Full frame consisting of front, rear, and side members. Join frame members with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
b. Front member: Type 1 hardwood or Type 2 hardwood with 1/8-inch Type 1 hardwood edge banding. Minimum 1 inch by 2-1/2 inch.
c. Rear member: Type 1 or Type 2 hardwood. Minimum 1 inch by 2-1/2 inches.
d. Side members: Type 2 hardwood. Minimum 3/4 inch by 1-1/2 inch.
e. Attach top frame to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

4. Tops:

a. 3/4-inch veneer core plywood.
b. Exposed edges: 1/8-inch, Type 1 edge banding.
c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
d. Provide hanging devices that, when slightly loosened, allow suspended cabinets to be carted horizontally.

5. Intermediate Rails:

a. Provide between drawers and doors and between drawers at all security panels.
b. Type 1 hardwood, minimum 3/4 inch thick.
c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

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6. Security Panels:

    a. 1/4-inch-thick medium density fiberboard let into intermediate rails.
    b. Provide on all base cabinets with locks, between drawers and door, and between drawers.

7. Toe space Rail:

    a. Install between end panels to provide a minimum toe space of 2-1/4 inches deep by 4 inches high.
    b. Type 2 hardwood or fir, 3/4 inch by 4 inches.

8. Backs:

    a. Unexposed interiors and exteriors: Minimum 3/16-inch hardboard.
    b. Exposed interiors and unexposed exteriors: 1/4-inch veneer core plywood.
    c. Exposed exterior backs: 3/4-inch veneer core plywood.
    d. Provide removable vertical split backs on all base cabinets, except units with security panels and sink cabinets, to allow access to service piping from the front of the unit.
    e. All sink cabinets to have partial height back panels to allow passage of the drain line and piping to the service chase.

9. Vertical Dividers:

    a. 1-1/2-inch veneer core plywood.
    b. Exposed edges: 1/8 inch. Type 1 hardwood edge banding.
    c. Attach to bottom, front top rail, and rear top rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

10. Adjustable Pullout Shelves:

    a. Shelf: 3/4-inch veneer core plywood.
    b. Retaining lip: Provide all around shelf, 2 inches above shelf surfaces, using 2-3/4 inch by 1/2-inch 9 ply Baltic birch veneer core plywood or 1/2-inch Type 2 hardwood.
    c. Adjustable on 1-1/4-inch centers.
    d. Front edge of shelf to be within 1 inch of inside face of door.
    e. Pullout shelves to fully extend with doors open at minimum of 90 degrees.

11. Hinged Doors:

a. 3/4-inch hardwood plywood, particleboard core with 1/8 inch, Type 1 hardwood edge banding.

12. Drawers:

a. Drawer box back, sides, and sub front: Minimum 1/2 inch 9 ply Baltic Birch veneer core plywood or 1/2 inch, Type 2 hardwood. Attach back, sub front and sides with 5/16-inch dowels and glue or multiple dovetail and glue.
b. Bottom: 1/4-inch hardboard. Dado bottom into back, sub front and sides sealed with hot melt glue around drawer bottom perimeter.
c. Removable drawer heads: 3/4-inch hardwood plywood, particleboard core with 1/8 inch edge banding or 3/4 inch, Type 1 hardwood.

B. Wall and Upper Cabinets:

1. End Panels:

a. 3/4-inch veneer core plywood.
b. Exposed edges: 1/8-inch Type 1 hardwood edge banding.
c. Provide 2 rows of drilled holes in each end panel, 1-1/4 inch on centers, to receive shelf clips.
d. Attach to top, bottom, and bottom rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

2. Tops:

a. 1-inch veneer core plywood.
b. Exposed edges: 1/8-inch, Type 1 hardwood edge banding.
c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

3. Bottoms:

a. 1-inch veneer core plywood.
b. Exposed edges: 1/8-inch, Type 1 hardwood edge banding.
c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

4. Backs:

a. 1/4-inch veneer core plywood.
b. Rabbeted backs and provide unexposed exterior hanger rails at the top and the bottom.

5. Adjustable Shelves:

a. 1-inch veneer core plywood.
b. Exposed edges: 1/8-inch Type 1 hardwood edge banding.
c. Adjustable on 1-1/4-inch centers.
d. Front edge of shelf to be within 1 inch of inside face of door.

6. Hinged Solid Doors:

a. 3/4-inch hardwood plywood, particleboard core with 1/8 inch, Type 1 hardwood edge banding.

7. Hinged Framed Glass Doors:

a. Frame: Minimum 3/4 inch by 2-3/4-inch, Type 1 hardwood.
b. Glass: tempered safety glass.
c. Assemble frame with mortise and tenon joints secured with glue.
d. Provide extruded vinyl retaining molding designed so glass can be replaced without tools.

C. Tall Cabinets:

1. End Panels:

a. 3/4-inch veneer core plywood.
b. Exposed edges: 1/8-inch Type 1 hardwood edge banding.
c. Provide 2 rows of drilled holes in each end panel, 1-1/4 inch on centers, to receive shelf clips.
d. Attach to top, bottom, and bottom rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

2. Tops:

a. 1-inch veneer core plywood.
b. Exposed edges: 1/8-inch Type 1 hardwood edge banding.
c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

3. Bottoms:

a. 3/4-inch veneer core plywood.
b. Exposed edges: 1/8-inch, Type 1 hardwood edge banding.
c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

4. Bottom Toe Space:

a. 3/4 inch by minimum 4-inch, Type 1 hardwood or fir.

b. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.

5. Backs:

a. 1/4-inch veneer core plywood.

6. Fixed and Adjustable Shelves:

a. 1-inch veneer core plywood.
b. Exposed edges: 1/8-inch, Type 1 hardwood edge banding.
c. Center shelf to be fixed by attaching to end panels with doweled and glue or mortise and tenon joints secured with glue and countersunk screws.
d. Adjustable on 1-1/4-inch centers.
e. Front edge of shelf to be within 1 inch of inside face of door.

7. Hinged Solid Doors:

a. 3/4-inch hardwood plywood particleboard core with 1/8 inch, Type 1 hardwood edge banding.

8. Hinged Framed Glass Doors:

a. Frame: Minimum 3/4 inch by 2-3/4-inch, Type 1 hardwood.
b. Glass: laminated safety glass.
c. Assemble frame with mortise and tenon joints secured with glue.
d. Provide extruded vinyl retaining molding designed so glass can be replaced without tools.

9. Framed Sliding Glass Doors:

a. Frame: Minimum 3/4 inch by 2-3/4-inch, Type 1 hardwood.
b. Glass: laminated safety glass.
c. Track assembly: Overhead aluminum track with adjustable nylon roller hangers and bottom aluminum channels with 2 plastic guides per door. Provide valance in front of track assembly.
d. Assemble frame with mortise and tenon joints secured with glue.
e. Provide extruded vinyl retaining molding designed so glass can be replaced without tools.

10. Sliding Solid Doors:

a. 3/4-inch hardwood plywood particle board core with 1/8 inch, Type 1 hardwood edge banding.
b. Track assembly: Overhead aluminum track with adjustable nylon roller hangers and bottom aluminum channels with 2 plastic guides per door.

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2.05 CANTILIVERED STUDENT BENCH:

A. Components:
   1. Island core support assemblies with insert panels and cantilevered adjustable work surface. Manufacturer: Mott Sigma Flex or approved equal.

2.06 KNEE OPENING FRAMES:

A. Components:

   1. Perimeter Rails: 3/4 inch by 4-1/8 inches solid Type 1 hardwood with a maximum span of 72 inches. Groove rails for "Z" irons or drill for top attachment.
   2. Reinforcing Cross Rails: Solid hardwood glued into front and back rail grooves and pinned at intervals not more than 33 inches on centers. Reinforce cross rails with glue blocks.
   3. Legs: 2 inches by 2 inch solid, Type 1 hardwood, one front and one rear at end and intermediate locations. Provide a coved vinyl or rubber base around leg, 2 inches in height, and in color to match room base.
   4. Leveling Glides: 2-inch diameter, two-piece pivot construction, steel housing, nonmarring, phenolic or translucent plastic insert, 1/2 inch diameter, minimum 1-1/2 inch long zinc plated stems on each leg.

B. Construction: For KO's between two cabinets or cabinet and wall, provide front and back perimeter rails with reinforcing cross rails, attached with steel angles to adjacent cabinets or wall. For KO's at the end of a bench, provide front, back, and side perimeter rails with reinforcing cross rails, attached with steel angles to cabinets and steel corner braces, grooved and screwed into both rails at each corner with legs. For KO benches, provide front, back, and side perimeter rails with reinforcing cross rails, attached with steel corner braces, grooved and screwed into both rails at each corner, and intermediate legs.

2.07 FILLER PANELS:

A. Provide filler panels and pipe chase enclosure panels at exposed to view areas between back of cabinets and walls, between backs of cabinets at end of island or peninsula benches, and at any other area necessary to enclose gaps. Provide all filler panels with bottom 6 inches fixed and the top portion removable.

B. Materials:

   1. 3/8-inch veneer core plywood.
   2. Edges: 1/8-inch, Type 1 hardwood edge banding.

C. Secure to frame and/or cabinet back and wall with metal angle and oval head screws with finishing washers.

D. KO Panels: Secure top of filler panels with metal angles and "Z" clips, and secure bottom of panels as detailed on the drawings.

2.08 HARDWARE:

A. Drawer and Hinged Door Pulls: (3/8 inch) (10 mm) diameter stainless steel bow wire pulls, (4-3/4 to 5 inches) (120 mm to 128 mm) center to center with radiused corners and a projection of (1 inch to 1-1/2 inches) (25 mm to 40 mm). Model 115.60.602 as manufactured by Hafele America (800) 423-3831, Model DP33B as manufactured by Mockett (800) 523-1269, or Model SS Bow 128 as manufactured by Schaub & Company (866) 724-2827. Or approved equal.

1. Provide with a clear abrasion and acid resistant powder coated finish.
2. Mount door pulls vertically, and drawer pulls horizontally.

B. Drawer and Pullout Shelving Slides:

1. Description: Full extension, ball bearing, rail mounted, multimembered slides fabricated of minimum 16 gage steel with an electro-zinc finish.
2. Manufacturers: Accuride International Incorporated, Santa Fe Springs, California; Waterloo Metal Stampings Limited, Kitchener, Ontario; Knape and Vogt, Grand Rapids, Michigan; A-Ventures, Incorporated, Charlotte, North Carolina; or equal.
3. Drawer Slides:

	Drawer Width	Accuride Model #	Maximum Dynamic Load Rating
a	(0-36 inches)	7432 (wood)	(100 pounds) (45 kg)
b	(Over 36 inches)	3640 (wood)	(200 pounds) (90 kg)

4. Pullout Shelving Slides

	Shelving Width	Accuride Model #	Maximum Dynamic Load Rating
a	(0-36 inches)	7432 (wood)	(100 pounds) (45 kg)
b	(Over 36 inches)	3640 (wood)	(200 pounds) (90 kg)

5. File Cabinet Drawer Slides:

	Drawer Width	Accuride Model #	Maximum Dynamic Load Rating
a	All Sizes	4034 (wood)	(150 pounds) (68 kg)

6. Slides shall have a positive stop at full extension and permit removal of drawer without use of tools. Drawers shall not lift out or otherwise be removable without the release of a locking device on each slide.

7. Dynamic Load Rating: Slides meet BIFMA "Business Institutional Furniture Manufacturers Association" Standards. 0.017 pounds per cubic inch at full travel plus or minus 1/4 inch for 50,000 cycles.

C. Hinges:

1. Description: Institutional type, 5-knuckle, wraparound design, projecting barrel, minimum 2-1/2 inches long.
2. Material: Type 304 stainless steel, minimum 0.095 inches thick.
3. Provide minimum of 2 hinges for doors under 48 inches high; minimum of 3 hinges for doors 48 inches to 84 inches high; and minimum of 4 hinges for doors over 84 inches in height.
4. Mounting: Wing for mounting to end panels shall have 4 holes, two of which are slotted for adjustability. Wing for door shall have 2 holes for mounting to the edge of the door and 3 holes for mounting to the inside face of the door, two of which are slotted for adjustability. Use stainless steel screws.

D. Door Catches: Roller type, adjustable, operating with a built-in tension spring. Provide all parts of cadmium plated steel except roller. Attach to top of base cabinet doors, the bottom of wall cabinet doors, and at the top and bottom of tall cabinet right-hand doors. Provide an elbow catch for the left-hand door of tall cabinets at the fixed center shelf.

E. Shelf clips: Die formed zinc plated steel pin and socket type or plastic twin-pin type. Provide shelf clips adjustable on 1-1/4-inch centers and meet seismic requirements.

F. Locks:

1. Provide with base and wall cabinets as shown on the Drawings.
2. Provide with all tall cabinets.
3. Description: 5-pin tumbler, heavy duty cylinder cam lock type.
4. Manufacturers: National Lock Company, Rockford, Illinois; Corbin, Berlin, Connecticut; Best Lock Corporation, Indianapolis, Indiana; Illinois Lock Company, Wheeling, Illinois; or equal.
5. Finish: Exposed surfaces of locks shall match other casework hardware.
6. Keying: Capacity for 2000 primary key changes. Master key 1 level with built-in flexibility to accommodate, if required, 3 levels: 1 Grandmaster, 59 Master groups and 70 Submaster groups with 13 primary changes under each.
7. Keys: Stamped brass available from manufacturer or local locksmith, and supplied in the following quantities unless otherwise specified:
   a. 2 for each keyed different lock.
   b. 3 for each group keyed alike locks.
   c. 2 for master keys for each system.

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G. File Suspension Rails: Provide each file drawer with a pair of 14 gage steel, file suspension rails.

H. Casters: Swivel type, 4 inch high, with wheel lock, Payson Model 050-3UM WK, or approved equal.

2.09 SERVICE CHASE PIPE SUPPORT ASSEMBLY:

A. Provide in all service chases whether piping is required.

B. Channels: As manufactured by Unistrut Corporation, Elcen, Grinnell Power-Strut, or approved equal. Provide assemblies as detailed on the Drawing. Unistrut part numbers are referenced.

C. Securely anchor entire assembly to floor and/or wall.

D. Space and position pipe support assemblies out of all knee opening and undercounter equipment locations.

2.10 TABLE FRAMES

A. Perimeter rails: 3/4 inch by 4-1/8-inch solid Type 1 hardwood, attached steel corner braces, grooved and screwed into both rails at each corner. Groove rails for "Z" irons or drill for top attachment.

B. Reinforcing cross rails: Solid hardwood glued into front and back rail grooves and pinned at intervals not more than 33 inches on centers in tables without drawers. Reinforce cross rails with glue blocks.

C. Legs: 2 inches by 2 inch solid, Type 1 hardwood.

D. Leveling glides: 2-inch diameter, two-piece pivot construction, steel housing, nonmarring, phenolic or translucent plastic insert, 1/2-inch diameter, minimum 1-1/2 inch long zinc plated stems.

2.11 T-FRAME TABLES

A. Upper horizontal rails: 2 inches by 2 inch by 11 gage thick reinforced steel channel.

B. Steel angle spreader for support of cabinets at bottom: Premium grade 3 inch by 3 inches by 1/4-inch steel angle.

C. Connecting bolts: Minimum 3/8-inch diameter commercially cadmium plated or stainless-steel bolts, nuts and washers, as protection against corrosion.

D. Legs: Vertical leg members of 2 inch by 2 inches by 11 gage thick steel channel. Upper and lower horizontal leg members of 3 inch by 2 inches by 11 gage thick steel channel. Weld leg members to form leg assembly at each end of table.

E. Construct table frame by bolting leg assemblies to upper horizontal rails and to lower support angles as detailed on the Drawings.

F. Leveling glides: 2-inch diameter, two-piece pivot construction, steel housing, nonmarring, phenolic or translucent plastic insert, 1/2 inch diameter, minimum 1-1/2 inch long zinc plated stems.

G. Casters: Swivel type, 4 inch high, with wheel lock.

H. Finish: Finish as specified for metal laboratory casework. Color selected by the Architect.

2.12 ADJUSTABLE TABLE FRAMES

A. Upper horizontal rails: 1-1/2 inch by 1-1/2 inch by 12 gage reinforced steel channel.

B. Legs: Vertical leg members of 1-1/2 inch by 1-1/2 inch by 12 gage thick steel tubing and/or channels. Height adjustment to be accomplished through spring bolts for each individual leg.

C. Construct table frame by bolting leg assemblies to upper horizontal rails and welding to lower support stretchers as detailed on the Drawings.

D. Leveling glides: 2-inch diameter, two-piece pivot construction, steel housing, nonmarring, phenolic or translucent plastic insert, 1/2-inch diameter, minimum 1-1/2 inch 38 mm long zinc plated stems.

E. Finish: Electrodeposition painting process, baked on to a hard satin finish. Color selected by the Architect.

2.13 WOOD FINISH

A. Preparation: Sand exposed surfaces smooth, free from dirt, defects, and mill marks resulting from machining.

B. Stain: Apply stain to all exposed exterior and interior casework surfaces. Allow surfaces to completely dry under controlled conditions before applying subsequent coats. Force dry in dust-free atmosphere, sand and wipe surfaces clean between coats. Apply and wipe dry in a manner to achieve a match with the selected color sample, upon completion of application of the finish coats. Color selection by Architect.

C. Finish surface: Smooth, satin luster finish. Provide water clear and bright finish on exterior and interior surfaces exposed to view. Cloudy, muddy finishes or finishes carrying tinting pigment will not be acceptable.

D. Finish coats: After staining, apply 1 coat of clear sealer and 2 coats of highly chemical resistant, catalyzed polyurethane or acrylic urethane to all exposed and unexposed surfaces.

2.14 METAL FINISH

A. Finish casework, casework support structure and other laboratory furnishings.

B. Preparation: Spray clean metal with a heated cleaner / phosphate solution, pretreat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.

C. Application: Electrostatically applied epoxy or urethane powder coat painting process that coats all hidden and exposed surfaces with an acid and abrasion resistant coating. Bake in a controlled high temperature oven to ensure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:
   1. Exterior and interior surfaces exposed to view: 1.5 mil average and 1.2 mil minimum.
   2. Backs of cabinets and other surfaces not exposed to view: 1.0 mil average.
   3. Finish drawer bodies in matching or harmonizing color and apply corrosion resistant treatment to selected, concealed interior parts.

D. Color: Selection by the Architect from nonstandard colors.

E. Metal Finish Performance Requirements:

   1. Abrasion Resistance: Maximum weight loss of 5.5 mg per 100 cycle when tested on a Taber Abrasion Tester Number E40101 with 1000 gm wheel pressure and Calibrase Number CS10 wheel.
   2. Hardness: Surface hardness equivalent to 4H or 5H pencil.
   3. Humidity Resistance: Withstand 1,000-hour exposure in saturated humidity at 100 degrees Fahrenheit.
   4. Moisture Resistance: No visible effect to surface finish after boiling water trickled over test panel inclined at 45 degrees Fahrenheit for 5 minutes. No visible effect to surface finish following 100-hour continuous application of a water-soaked cellulose sponge, maintained in a wet condition throughout the test period.
   5. Adhesion: Score finish surface of test panel with razor blade into 100 squares, 1/16 inch by 1/16 inch, cutting completely through the finish but with minimum penetration of the substrate, and brush away particles with soft brush. Minimum 95 squares shall maintain their finish.

6. Salt Spray: Withstand minimum 200-hour salt spray test, conforming to ASTM B117-59 procedure.

2.15 WORK SURFACES

A. Epoxy Resin:

1. Manufacturer: Durcon Laboratory Tops, Inc.; Epoxyn Products; or approved equal.
2. Thickness: 1 inch thick unless otherwise noted on Drawings. Check thickness before fabrication. Each corner of top shall not deviate more than plus or minus 1/32 inch from nominal.
3. Warpage: Check top for warpage before fabrication. Place slab on a true plane formed by a surface plate of Tool Room Grade B or better. Measure in unrestrained condition. Top will be accepted for use if there is no gap exceeding 1/16 inch in a 36-inch span or 3/32 inch in a 96 inch span.
4. Fabrication:

    a. Provide in longest practical lengths. Bond all joints with a highly chemical and corrosion resistant cement having similar properties as the base material. Provide a 1/8-inch-wide drip groove on underside of all exposed edges set back 1/2 inch from edge of top. Finish exposed edges.
    b. Size Tolerances: Length, plus or minus 1/8 inch. Width, plus or minus 1/16 inch.
    c. Squareness: Plus, or minus 1/64 inch for each 12 inches. A top spanning 48 inches held to plus or minus 1/16 inch.
    d. Location of Cutouts and Drillings: Plus, or minus 1/8 inch.
    e. Sizes of Cutouts and Drillings: Plus 1/8 inch, minus 0.
5. Curbs: Supply loose for field application in same thickness as countertops. Provide curbs 4 inches high unless otherwise indicated on Drawings. Where tops abut wall, casework, or fume hood, supply an end curb. Caulk joints between curb and walls, fume hoods, and cabinets with acid-resistant silicone caulk.
6. Color: To be selected by the Architect from the Manufacturer's standard black, gray, or white colors.

B. Solid Phenolic Resin:

A. Manufacturer: Trespa North America, Ltd., 12267 Crosthwaite Circle, Poway, California, 92064, (800) 487-3772, FunderMax North America Inc. 9401-P, Southern Pine Road, Charlotte NC, 28273, (980) 299-0035 or approved equal.
B. Thickness: 1 inch thick unless otherwise noted on Drawings. Check thickness before fabrication. Each corner of top shall not deviate more than plus or minus 1/32 inch from nominal.
C. Provide in longest practical lengths to provide minimum number of joints.
D. Installation Materials: Provide solid phenolic laboratory top manufacturer's joint adhesive and sealants as required to suit project conditions.

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E. Fabrication:

a. Fabricate solid phenolic laboratory tops in accordance with manufacturer's recommendations, approved submittals and SEFA 8.

1) Comply with requirements of AWI Premium grade.

b. Edge Treatment:

1) Ease all top edges and vertical corners to 1/4 inch radius and sand smooth.
2) Provide drip groove unless otherwise indicated.

F. Curbs: Supply loose for field application in same thickness as countertops. Provide curbs 4 inches high unless otherwise indicated on Drawings. Where tops abut wall, cabinets, or fume hood, supply an end curb. Caulk joints between curb and walls, fume hoods, and cabinets with acid-resistant silicone caulk.

G. Color: Manufacturer's standard colors.

H. Finish: Matt sheen.

C. Plastic Laminate:

A. Thickness: 1 inch thick unless otherwise noted on Drawings.

2. Fabrication:

a. Finish at the factory and include all machine drilling and cutouts.
b. Edges: Band with 1/8-inch PVC. Trim and sand smooth with all edges and corners radiused.
c. Size Tolerances: Length, plus or minus 1/8 inch. Width, plus or minus 1/16 inch.
d. Squareness: Plus, or minus 1/64 inch for each 12 inches. A top spanning 48 inches; held to plus or minus 1/16 inch.
e. Location of Cutouts and Drillings: Plus, or minus 1/8 inch.
f. Sizes of Cutouts and Drillings: Plus 1/8 inch, minus 0.

3. Curbs: Supply loose for field application in same thickness as countertops. Provide curbs 4 inches high unless otherwise indicated on Drawings. Where tops abut wall, casework, of fume hood, supply an end curb. Caulk joints between curb and walls, fume hoods, and cabinets with acid-resistant silicone caulk.

4. Color: To be selected by the Architect.

D. Stainless Steel:

1. Thickness: 16 gage, Type 304, stainless steel with a Number 4 polish finish over a hardwood perimeter frame with a total thickness of 1 inch, unless otherwise noted on Drawings.
2. Fabrication:

   a. Finish at the factory and include all cutouts. Provide top with 1/2-inch return flange under frame and 16 gage steel reinforcing channels applied to underside of top where necessary to ensure rigidity. Coat underside of top with sound dampening material.
   b. Form edges, flanges, and curbs integrally with top from 1 sheet of metal. Provide with marine edges unless otherwise noted on Drawings. Provide curbs 4 inches high.
   c. Joints: Electrically weld all shop and field joints; grind smooth and polish.
   d. Size Tolerances: Length, plus or minus 1/8 inch. Width, plus or minus 1/16 inch.
   e. Squareness: Plus, or minus 1/64 inch for each 12 inches. A top spanning 48 inches; held to plus or minus 1/16 inch.
   f. Location of Cutouts and Drillings: Plus, or minus 1/8 inch.
   g. Sizes of Cutouts and Drillings: Plus 1/8 inch, minus 0.
   h. Caulk joints between curb and walls, fume hoods, and cabinets with acid-resistant silicone caulk.

2.16 SINKS

A. Epoxy Resin Sinks:

1. Description: Integrally molded from modified thermosetting black epoxy resin, and oven cured. Minimum wall thickness of 1/2 inch with all interior corners coved to 1-1/2-inch radius and bottoms pitched to end outlet opening. Provide with 1-1/2-inch outlet and open-end overflow standpipe. Overflow to be 2 inches shorter than depth of sink.
2. Manufacturers: Durcon Laboratory Tops; Epoxyn Products; or equal.
3. Support sinks with two 1/4 inch thick by 2-inch-wide steel straps fastened to horizontal front and back rails with 1/4 inch by 3/4-inch flat head machine screws. Provide 2 adjustable glides for each strap to support the sink at the front and back corners.
4. Drop-in sinks, supported by an upper flange from the benchtop, are acceptable.
5. Caulk joint between top and sink with nonhardening mastic.
6. Provide with tailpiece; Town & Country Plastics Model PP-18, R&G Sloane Part Number 7218; or Scientific Plastics Company, Inc., Part Number W81595-158.

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2.17 LABORATORY SERVICE FIXTURES

A. General:

1. Installation: Provide and installed at point of use all service fixtures. Connect to the service piping systems specified in Division 15. Provide the product of 1 manufacturer for all laboratory service fixtures, including fixtures supplied with fume hoods. Provide all fixtures designed for laboratory use.
2. Manufacturers: Water Saver Faucet Company or Chicago Faucet Company or approved equal. Water Saver fitting numbers are referenced on the Drawings.
3. Materials: Provide the bodies of service valves, fixtures and accessories of cast or forged brass with a minimum copper content of 85 percent. Faucets shall have a tapered body design. Fabricate assembly components and operating parts such as valve stems, renewable units, packing nuts, outlet nozzles, and straight serrated hose ends from solid brass bar stock. Fabricate replaceable seats, needle cones, valve disc screws, and other accessories from monel metal or stainless-steel alloys especially selected for use intended.
4. Assembled at the factory: Service fixtures, including the mounting of valves and shanks to turrets, flanges, and other mounting accessories.
5. Furnish and install nipples, locknuts, shanks and other accessories required to properly mount and connect the fixtures.
6. Testing: Individually factory test fixtures. Valves and fixtures, except water fixtures, shall withstand a test pressure of 100 pounds per square inch. Test water fixtures at 80 pounds per square inch. Test fixtures for gases under water.
7. Fixtures located on the same plane shall have their handles project the same distance from the plane of reference to present a uniform, related appearance, regardless of valve type.

B. Water Valves:

1. Renewable unit containing all working parts which are subject to wear, including stainless steel or monel metal seat, monel metal screw, heavy duty seat disk, Teflon packing, and an integral or external adjustable volume control.
2. Provide unit capable of being readily converted from compression to self-closing, and vice versa, without disturbing faucet body proper and shall also be capable of being readily converted from water construction to needle valve or steam valve construction without disturbing faucet body.
3. Provide unit sealed in valve body with special composition gasket. Metal-to-metal or ground-joint type of sealing not acceptable.

C. Goosenecks: Hot water/cold water gooseneck mixers shall swivel. Provide swivel point at turret or at valve level if wall or panel mounted. Provide swing joints with heavy Teflon packings. All goosenecks shall provide full thread for attachment of ant splash outlet fixtures, serrated tips or filter pumps.

D. Outlets: Provide with removable aerators.

E. Pedestal Type Fixtures: Cast aluminum box complete with cover plates. Fabricate units with sloped single face or double face, as indicated, and conceal mounting holes in base for attaching to casework. Provide holes tapped for conduits and grounding screws. Coordinate required face plates with receptacles and other devices specified in Division 16.

F. Fixture Finish:

1. Chrome finish, over all visible areas, developed by the following sequence of plating's over properly prepared brass castings or forgings:

Plating	Minimum Plating Thickness
Copper (Initial)	(0.000050 inches)
Nickel	(0.000350 inches)
Chromium (Final)	(0.000015 inches)

2. Provide laboratory service fixtures with an acid and solvent resisting clear plastic coating applied over a cleaned, polished, chrome plated surface. Spray and bake coating surfaces 3 times with a minimum coating thickness of 2–3 mil. Assemble faucet and valve components after surfaces have been coated, and test at 100 pounds air under water.
3. Test coating by suspending samples in a 6 cubic foot capacity container approximately 12 inches above open beakers, each containing 199 cc of 75 percent nitric acid, 94 percent sulfuric acid, and 37 percent hydrochloric acid, respectively. After exposure to these fumes for 150 hours, finish shall show no rupture, though slight discoloration or possible softening is permissible.

G. Faucet and Valve Handles: Chrome plated, 4-arm type or wrist blade type with removable screw-on type colored plastic discs with identification lettering stamped on disc in a contrasting color as scheduled below.

Service	Disc Color	Lettering Color	Lettering
Cold Water	Green	White	CW
Hot Water	Red	White	HW

H. Wrist Blade Handles: Install handles so blades are perpendicular to the benchtop in the off position and horizontal to the benchtop in the open position.

2.18 EMERGENCY SHOWER AND EYEWASH UNITS

A. Manufacturers: Water Saver Faucet Company or Chicago Faucet Company. Water Saver fitting numbers are referenced on the Drawings. Or approved equal.

B. Deck Mounted Eye, Face, and Body Spray Units:

1. Dual purpose eyewash/drench hose unit.
2. The angled dual head body and valve of forged brass.
3. The squeeze handle of stainless steel with plastic cover.
4. The handle and deck flange of molded nylon, with handle locator guides.
5. Provide self-closing valve with a locking clip to hold the valve open once the unit is activated.
6. Provide unit with dual, polypropylene, angled, gentle spray heads; polyurethane filter; integral volume control; integral backflow preventer; and integrated nylon flip-top dust cover.
7. Finish: Match laboratory service fitting finish.
8. Provide with 8-foot-long high pressure, reinforced PVC hose.

2.19 SHELVING

A. Wood Shelves: 1-inch-thick veneer core hardwood plywood with a maximum span of 42 inches. Provide 1/8-inch solid hardwood facer on all exposed edges.

B. Adjustable Wall and Island Shelving:

1. Standards: Double-slotted type, 30 inches long unless otherwise noted on Drawings. Satin zinc finish. Garcy Corporation, Number 3225; E.B. Bradley, Number 44; or equal.
2. Brackets: 16 gage metal with 3 blade hooks. Screw shelves to each bracket. Finish as specified for metal finish in this section, with color selected by the Architect.

2.20 DRYING RACKS (STAINLESS STEEL)

A. Manufacturers: Mod-Rack by Inter-Dyne; 676 Ellis Road; Norton Shores, Michigan 49441, (231-799-8760). Or approved equal.

B. Body: One-piece, 20 gage, Type 304 stainless steel with a Number 4 finish. Provide top with two 90-degree bends and sides with one 90-degree bend. Bottom shall have two 90-degree bends to provide an integral drip trough and catch drain. Provide front with a multiple of T-shaped holes to accommodate pegs.

C. Pegs: Injection molded white polypropylene, 1/2-inch diameter by 6 inches long. T-shaped protrusion on base of pegs shall allow easy removal and replacement without need for tools. Design T-shaped holes to fit protrusion on support pegs for holding single or multiple utensil drip trays, drain shelves, funnel racks, or pipette holders. Provide five 2-3/4-inch peg extenders for each drying rack.

D. Drip Trough: 4 inch wide, 20 gage, Type 304 stainless steel with a 3/8-inch OD stainless drain tube and a stainless-steel screen insert. Screen; 16 gage, 14 by 14 mesh, 0.025 wire. Provide with a 3/8-inch ID flexible drain tube minimum of 30 inches long.

E. Provide with hanger to allow removal and replacement of entire rack for cleaning without need for tools.

F. Finished Backs: Provide with all units not mounted on walls. Fabricate from 20 gage, Type 304 stainless steel with a Number 4 finish.

2.21 STAINLESS STEEL SCULLERY SINK

A. Manufacturers:

1. Just Manufacturing Company
2. Elkay Manufacturing.
3. Or Approved Equal

B. Fabricate from 14 gage, Type 304 stainless steel with a Number 4 finish. Provide 1 inch radius cove at vertical and horizontal corners and pitch bottom to drain. All sink joints: butt welded, ground smooth and polished to render all joints seamless. Soldering will not be permitted in conjunction with sink unit construction. Provide all sink units designed and fabricated with sufficient reinforcement to prevent oil canning. Apply heavy mastic type sound deadening coating to underside of sinks, tops, backsplashes, and side splashes. Fixture holes to be reinforced with a continuous 14 gage hat channel on the backside of the backsplash. Length as required for fixture quantity. Provide 1 inch wide by 4-inch-high side splash where sink abuts a vertical surface. Caulk joint between sink unit and any vertical surface with an acid-resistant silicone caulk.

C. Sink: Provide with stainless-steel open-end overflow standpipe, strainer, and tailpiece. Standpipe to be 2 inches shorter than depth of sink.

D. Frame and leg members: 2 inches square, 14 gage. Provide horizontal front shelf support frame members to be removable as detailed on the Drawings. All other connections welded with a Number 4 finish. Provide leg members with leveling glides.

2.22 GROWTH SHELVING

A. Manufacturer: Gardeners Supply Company, Burlington, VT, or approved equal.

B. High-Intensity 3-Tier LED grow lights, powder coated aluminum frame with three watertight shelf trays; each tray is 46-5/8”L x 15-1/2”W x 2”D. Overall dimension of shelving 51”L x 14-5/8”W x 68-1/2”H.

2.23 GROMMETS IN COUNTERTOPS

A. Manufacturer: Outwater Plastic Industries, Wood Ridge, New Jersey, (800) 631-8375, Model Number 35 DG, Dove Gray, or approved equal.

B. Seal Grommets to bench with silicone sealer.

2.24 SOURCE QUALITY CONTROL TESTING OF WOOD FINISH

A. Wood Finish: Meet or exceed the latest edition of the following Section and Articles of SEFA-8 Recommended Practices.

8.0 Cabinet Surface Finish Test
8.1 Chemical Spot Test
8.2 Hot Water Test

B. Testing Requirements: Provide a third-party tester that is not a representative of the Manufacturer or Installation Contractor

2.25 TEST RESULTS: SUBMIT A CERTIFIED REPORT PROVIDING TEST RESULTS AND INDICATING THE FINISH CONFORMS WITH OR EXCEEDS THE ABOVE SEFA-8 RECOMMENDED PRACTICES

A. Metal Finish: Meet or exceed the latest edition of the following Section and Articles of SEFA-8 Recommended Practices.

8.0 Cabinet Surface Finish Test
8.1 Chemical Spot Test
8.2 Hot Water Test
8.3 Impact Test
8.4 Paint Adhesion on Steel
8.5 Paint Hardness on Steel

B. Testing Requirements: Provide a third-party tester that is not a representative of the Manufacturer or Installation Contractor

C. Test Results: Submit a certified report providing test results and indicating the finish conforms with or exceeds the above SEFA-8 Recommended Practices.

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2.26 SOURCE QUALITY CONTROL TESTING OF EPOXY RESIN WORK SURFACE

A. Test Procedure: Apply 5 drops of each reagent to surface and cover with 25 mm watch glass, convex side down; test volatiles using 1-ounce bottle stuffed with saturated cotton. After 24-hour exposure flush surface, clean, rinse and wipe dry.

B. Evaluation Ratings: Describe by the following ratings, changes in surface finish and function:

1. No Effect: No detectable change in surface material.
2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

C. Test Results: Submit a report of the test results. Provide results equal to or better than the following.

	Reagent	Rating
1.	Hydrochloric Acid, 37 percent	Excellent
2.	Sulfuric Acid, 33 percent	No Effect
3.	Sulfuric Acid, 77 percent	No Effect
4.	Sulfuric Acid, 96 percent	Failure
5.	Formic Acid, 90 percent	Excellent
6.	Nitric Acid, 20 percent	Excellent
7.	Nitric Acid, 30 percent	Excellent
8.	Nitric Acid, 70 percent	Good
9.	Hydrofluoric Acid, 48 percent	Fair
10.	Phosphoric Acid, 85 percent	No Effect
11.	Chromic Acid, 60 percent	Failure
12.	Acetic Acid, 98 percent	Excellent
13.	3 & 8 Equal Parts	Excellent
14.	Ammonium Hydroxide, 28 percent	No Effect
15.	Sodium Hydroxide, 10 percent	No Effect
16.	Sodium Hydroxide, 20 percent	No Effect
17.	Sodium Hydroxide, 40 percent	No Effect
18.	Sodium Hydroxide Flake	No Effect
19.	Sodium Sulfide	Excellent
20.	Zinc Chloride	No Effect
21.	Tincture of Iodine	Excellent
22.	Silver Nitrate	No Effect
23.	Methyl Alcohol	No Effect

24.	Ethyl Alcohol	No Effect
25.	Butyl Alcohol	No Effect
26.	Benzene	Excellent
27.	Xylene	No Effect
28.	Toluene	Excellent
29.	Gasoline	No Effect
30.	Dichloroacetic Acid	Good
31.	Dimethylformamide	Excellent
32.	Ethyl Acetate	No Effect
33.	Amyl Acetate	Excellent
34.	Acetone	Excellent
35.	Chloroform	Excellent
36.	Carbon Tetrachloride	No Effect
37.	Phenol	Excellent
38.	Cresol	Excellent
39.	Formaldehyde	No Effect
40.	Trichlorethylene	Excellent
41.	Ethyl Ether	Excellent
42.	Furfural	Good
43.	Methylene Chloride	Excellent
44.	Monochlorobenzene	Good
45.	Dioxane	Excellent
46.	Methylethyl Ketone	Excellent
47.	Acid Dichromate	Fair
48.	Hydrogen Peroxide	No Effect
49.	Naphthalene	Excellent

2.27 SOURCE QUALITY CONTROL TESTING OF PLASTIC LAMINATE SURFACES

A. Test Procedure: Apply five (5) drops of each reagent to surface and cover with watch glass. Saturate 1-inch glass wool balls with 3 cc of solvent and cover with a small beaker. After 16 hours, wash off reagents and solvents with clear water and let dry.

B. Evaluation Ratings: Describe by the following ratings, changes in surface finish and function:

A = Unaffected
B = Very slight stain or roughening
C = Raised or roughened

C. Test Results: Submit a report of the test results. Provide test results equal to or better than the following:

	Acids	Results
1.	Nitric, 70 percent	C

2.	Glacial Acetic	A
3.	Sulfuric, 77 percent	A
4.	Sulfuric, 96 percent	C
5.	Hydrochloric, 37 percent	A
6.	Phosphoric, 75 percent	A
7.	Phosphoric, 90 percent	A
8.	Formic, 50 percent	A
9.	Formic, 90 percent	A
10.	Acetic, 10 percent	A
11.	Acetic, 98 percent	A
12.	Hydrofluoric, 48 percent	B
13.	Aqua Regia	A
14.	Chromium Trioxide	B
15.	Perchloric	A
16.	Uric	A
	Solvents	Results
17.	Carbon Tetrachloride	A
18.	Carbon Disulfide	A
19.	Acetone	A
20.	Formaldehyde	A
21.	Methanol	A
22.	Ethyl Acetate	A
23.	Toluene	A
24.	n-Hexane	A
25.	Ethyl Ether	A
26.	Chloroform	A
27.	Phenol, 40 percent	B
28.	Phenol, 85 percent	B
29.	Benzene	A
30.	Xylene	A
31.	Butyl Alcohol	A
32.	Amyl Alcohol	A
33.	Amyl Acetate	A
34.	Cresol	A
35.	Methylene Chloride	A
36.	Methylethyl Ketone	A
37.	Naphthalene	A
	Bases	Results
38.	Sodium Hydroxide, 40 percent	A
39.	Sodium Sulfide	A
40.	Ammonium Hydroxide, 28 percent	A
	General Reagents	Results
41.	Sodium Hypochlorite, 5 percent	A
42.	Calcium Hypochlorite	A
43.	Hydrogen Peroxide, 3 percent	A
44.	Gasoline	A

45.	Kerosene	A
46.	Mineral Oil	A
47.	Silver Nitrate, 10 percent	A

2.28 SOURCE QUALITY CONTROL TESTING OF SOLID PHENOLIC RESIN WORK SURFACE

A. Test Procedure: Apply 5 drops of each reagent to surface and cover with 1-inch watch glass, convex side down; test volatiles using 1-ounce bottle stuffed with saturated cotton. After 24-hour exposure flush surface, clean, rinse and wipe dry.

B. Evaluation Ratings: Describe by the following ratings, changes in surface finish and function:

1. No Effect: No detectable change in surface material.
2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

C. Test Results: Submit a report of the test results. Provide results equal to or better than the following:

	Reagent	Rating
1.	Hydrochloric Acid, 10 percent	No Effect
2.	Hydrochloric Acid, 37 percent	No Effect
3.	Sulfuric Acid, 33 percent	No Effect
4.	Sulfuric Acid, 77 percent	Excellent
5.	Sulfuric Acid, 96 percent	Excellent
6.	Nitric Acid, 20 percent	No Effect
7.	Nitric Acid, 30 percent	No Effect
8.	Nitric Acid, 70 percent	No Effect
9.	Hydrofluoric Acid, 48 percent	No Effect
10.	Chromic Acid, 60 percent	No Effect
11.	Acetic Acid, 99 percent	No Effect
12.	Ammonium Hydroxide, 28 percent	No Effect
13.	Sodium Hydroxide, 10 percent	No Effect
14.	Sodium Hydroxide, 20 percent	No Effect
15.	Sodium Hydroxide, 40 percent	No Effect
16.	Sodium Hydroxide Flake	No Effect
17.	Silver Nitrate 1 percent	No Effect

18.	Methyl Alcohol	No Effect
19.	Ethyl Alcohol	No Effect
20.	Xylene	No Effect
21.	Toluene	No Effect
22.	Dichloroacetic Acid	No Effect
23.	Dimethylformamide	No Effect
24.	Ethyl Acetate	No Effect
25.	Acetone	No Effect
26.	Phenol 90 percent	No Effect
27.	Formaldehyde 37 percent	No Effect
28.	Trichloroethylene	No Effect
29.	Ethyl Ether	No Effect
30.	Furfural	No Effect
31.	Methylethyl Ketone	No Effect
32.	Potassium permanganate 10 percent	No Effect
33.	Ferric (III) chloride 10 percent	No Effect
34.	Copper sulphate 10 percent	No Effect
35.	Sodium hypochlorite 13 percent	No Effect
36.	Sodium chloride 10 percent	No Effect
37.	Ethylene glycol	No Effect
38.	Dichloromethane	No Effect
39.	Acetic anhydride	No Effect
40.	n-Butyl acetate	No Effect
41.	n-Hexane	No Effect
42.	Methylisobutylketone	No Effect
43.	Tetrahydrofurane	No Effect
44.	Acridine orange 1 percent	No Effect
45.	Basic fuchsin 1 percent	No Effect
46.	Carbol fuchsin 1 percent	No Effect
47.	Malachite green oxalate 1 percent	No Effect
48.	Methylene blue 1 percent	No Effect
49.	Methyl violet 2B 1 percent	No Effect
50.	Wright stain 1 percent	No Effect
51.	Gentian Violet (dye) 1 percent	No Effect

PART 3 EXECUTION

3.01 INSTALLATION

A. Casework Installation:

1. Install, plumb, level, true and straight with no distortions. Shim as required, using concealed shims. Securely anchor to building structure. Where laboratory

furniture abuts other finished work, scribe and apply filler strips for accurate fit with fasteners concealed where practicable.

2. Installation of each individual bench run shall start at the high point of the floor under that bench run with levelers screwed in as much as possible.
3. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
4. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by Manufacturer.
5. Securely fasten tall cabinets, fume hood superstructures and tall flammable storage cabinets to solid support material near top of cabinet.
6. Reinforcement of stud walls to support cabinets, shelving, and other wall mounted laboratory furnishing items: Done during wall erection by trade involved. Laboratory furniture company/supplier is responsibility for indicating on Shop Drawings the accurate location and sizing of reinforcement.

B. Wall Cabinet Installation:

1. Securely fasten to solid supporting material, not plaster, lath, or wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets.
2. Reinforcement of stud walls to support wall mounted cabinets: Done during wall erection by trade involved. Laboratory furniture company/supplier is responsibility for indicating on Shop Drawings the accurate location and sizing of reinforcement.

C. Work Surface Installation:

1. Field jointing where practicable: Made in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by Manufacturer. Locate field joints as shown on accepted Shop Drawings, factory prepared so that there is no job site processing of top and edge surfaces.
2. Abut top and edge surfaces in 1 true plane, with internal supports placed to prevent any deflection.
3. Provide all holes and cutouts as required for built-in equipment and mechanical and electrical service fixtures. Prior to making openings, verify size of opening with actual size of equipment to be used. Form inside corners to a radius of not less than 1/8 inch. After sawing, rout and file cutouts to ensure smooth, crack free edges. Seal exposed edges after cutting with a waterproofing material recommended by manufacturer.
4. Secure tops to support with concealed Z-Type, angle type fastening, or equivalent devices spaced no more than 3 feet on center.
5. Plastic laminate worktop joints: 1/4-inch diameter bolt type "dog-bone" or "tite-joint" fasteners routed into bottom surface of worktops. Provide flush hairline joints in top units.
6. Epoxy Resin Work Surface Joints: 3/32-inch flush and smooth.

SECTION 123553.19

LABORATORY CASEWORK AND FURNISHINGS

D. Sink Installation: Set in chemical resistant sealing compound sinks which were not factory installed and secured and supported per manufacturer's recommendations.

E. Accessory Installation: Install accessories and fixtures in accordance with manufacturer's recommendations.

3.02 ADJUSTING

A. Repair or remove and replace defective work, as directed by Owner's Representative upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.03 CLEANING AND PROTECTION

A. Clean shop finished casework, touch up as required, and remove and refinish damaged or soiled areas.

B. Cover casework for protection against soiling and deterioration during remainder of construction period.

C. Clean countertops with diluted dishwashing liquid and water leaving tops free of all grease and streaks. Use no wax or oils.

D. If steel wool is used in cleaning stainless steel, use only stainless wool.

E. Protect casework before, during, and after installation. Materials damaged due to improper protection are cause for rejection.

END OF SECTION 123553.19

SECTION 12 36 23.13

PLASTIC-LAMINATE-CLAD COUNTERTOPS

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.

1.02 SUMMARY

A. Section Includes Plastic-laminate-clad countertops.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
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.

C. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
3. Apply WI Certified Compliance Program label to Shop Drawings.

D. Samples: Plastic laminates in each type, color, pattern, and surface finish required in manufacturer's standard size.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For the following:

1. Composite wood and agrifiber products.
2. High-pressure decorative laminate.
3. Chemical-resistant, high-pressure decorative laminate.
4. Adhesives.

B. Quality Standard Compliance Certificates: WI Certified Compliance Program.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.05 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 Certification: WI's Certified Compliance Program licensee.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install countertops 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.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from WI certification program indicating that countertops comply with requirements of grades specified.

2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

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. Abet Laminati (Basis of Design)
b. Formica Corporation.
c. Lamin-Art, Inc.
d. Nevamar; a Panolam Industries International, Inc. brand.
e. Wilsonart LLC.
f. Or equal.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements: As indicated in “Material and Finish Schedule” on Drawings.

E. Edge Treatment: Same as laminate cladding on horizontal surfaces.

F. Core Material: Exterior-grade plywood.

G. Core Thickness: 3/4 inch. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

2.02 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated. 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 countertop and quality grade specified unless otherwise indicated. Softwood Plywood: DOC PS 1.

2.03 ACCESSORIES

A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Outside Diameter: 2 inches.
2. Color: Black,

2.04 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Adhesives: 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. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.05 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets.

C. Complete fabrication, including assembly, 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 countertop 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.

D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, 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. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.02 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, 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.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.03 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 12 36 61.16

SOLID SURFACING COUNTERTOPS

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.

1.02 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material apron fronts.

1.03 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. 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.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size solid surface material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material 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.

1.06 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.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop 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.

1.07 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.08 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.01 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Basis of Design Product: Design is based on products indicated in “Material and Finish Schedule” on Drawings. Subject to compliance with requirements, provide indicated product or comparable product from one of the available manufactures.
2. Available 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. Avonite Surfaces.
    b. E. I. du Pont de Nemours and Company.
    c. Formica Corporation.
    d. Wilsonart LLC.
    e. Or equal.

3. Colors and Patterns: As indicated by manufacturer's designations.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.02 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards." Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 3/4-inch-thick, solid surface material with front edge built up with same material.

D. Backsplashes: 3/4-inch-thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.03 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer. Adhesives shall have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates to receive solid surface material countertops 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.

3.02 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 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 solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with 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. 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. Seal edges of cutouts in particleboard subtops by saturating with varnish.

I. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

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 Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Roll-up rail mats.
2. Recessed frames.

1.03 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor frames.
4. Custom Graphics: Scale drawing indicating colors.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.
2. Tread Rail: Sample of each type and color.
3. Frame Members: Sample of each type and color.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Uniform floor load of 300 lbf/sq. ft..
2. Wheel load of 350 lb per wheel.

B. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and 2019 CBC.

2.02 ROLL-UP RAIL MATS

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. C/S Group.
2. Babcock-Davis.
3. Forbo Industries, Inc.
4. JL Industries, Inc.; a division of the Activar Construction Products Group.
5. Kadee Industries, Inc.
6. Nystrom.
7. Or equal.

B. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 1-1/2 inches wide by 3/8 inch thick, sitting on continuous vinyl cushions.

1. Tread Inserts: Ribbed-design-surface, resilient vinyl.
2. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of industry colors.
3. Rail Color: Mill finish.
4. Hinges: Aluminum.
5. Mat Size: As indicated.

2.03 FRAMES

A. Recessed Frames: Manufacturer's standard extrusion. Extruded Aluminum: ASTM B221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52. Color: Mill finish.

2.04 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.05 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.06 ALUMINUM FINISHES

A. Mill finish.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

1. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
2. Delay setting mats until construction traffic has ended.

3.03 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION

SECTION 21 05 17

SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 SLEEVE-SEAL SYSTEMS

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. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).

C. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 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. 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.

2. Using grout, 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. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements for fire stopping specified in Section for "Penetration Fire stopping."

3.02 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.

3.03 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 wall sleeves.
   b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller than NPS 6 Cast-iron wall sleeves with sleeve-seal system.

      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 wall sleeves with sleeve-seal systemized-steel-pipe sleeves with sleeve-seal system.

      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 wall sleeves with sleeve-seal system

      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 wall sleeves with sleeve-seal system.

      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: PVC-pipe sleeves.
b. Piping NPS 6 and Larger: PVC-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: PVC-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 21 05 18

ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.02 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.01 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 piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

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: One-piece, floor-plate type.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 21 05 53

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch thick, with predrilled 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 self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. 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.

C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) 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.

2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving,1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

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.

2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

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.

PART 3 - EXECUTION

3.01 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.

3.02 LABEL INSTALLATION

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 or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Piping Color-Coding: Painting of piping is specified in Section 099100 "Painting."

F. 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. 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 [25 feet along each run. Reduce intervals to 12 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION

SECTION 21 13 13

WET PIPE SPRINKLER AND STANDPIPE SYSTEM

PART 1 - GENERAL

1.01 GENERAL AND SPECIAL CONDITIONS:

A. General and special conditions apply to the work in this section

B. The Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire protection system, with said system being made ready for the operations in accordance with the requirements of the Authority Having Jurisdiction. The purpose of the permit drawings and specifications is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable. The omission of the Owner of any necessary system component as required by the Authority Having Jurisdiction, in the specifications shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the owner. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions that may be material to the performance of his work. No extra payment will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the owner, Architect, Engineer for clarification prior to the bid due date.

C. The Contractor shall provide all devices and equipment required by these specifications. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.

D. This Section specifies materials, methods, and equipment to be used for automatic sprinkler system or a combine standpipe system and related fire protection piping to 5 ft outside building.

E. This Section specifies design criteria for fire protection system. Demo and retrofit layouts for fire protection system have been established, as it relates to architecture, structure and mechanical/electrical systems. Fire Protection Contractor, based on these layouts, shall produce installation drawings, which are referred to as shop drawings in this Specification.

1.02 SYSTEM ABBREVIATIONS AND DEFINITIONS

A. AHJ – Authority Having Jurisdiction

B. ANSI – American National Standard Institute

C. Approved – Unless otherwise stated, materials, equipment or submittal approved by the Engineer.

D. ASTM – American Society for Testing and Materials

E. AWS – American Welding Society

F. AWWA – American Water Works Association

G. Concealed – Where used in connection with installation of piping or conduit and accessories, shall mean, “Hidden from sight” as in shafts, furred spaces, in soffits or above suspended ceilings.

H. Contractor – The Company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers, or fabricators.

I. Engineer – P2S Inc.

J. Exposed - Where used in connection with installation of piping or conduit and accessories, shall mean, “visible” or “not concealed”.

K. FDC – Fire Department Connection

L. FM – FM Global.

M. FM Approved – Materials or equipment approved by Factory Mutual and included on the most recent edition of the FM Approval Guide.

N. Furnish – Supply materials.

O. GPM – Gallons per minute.

P. Install – Install materials, mount, and connection equipment assemblies.

Q. NFPA – National Fire Protection Association

R. PIV – Post indicating valve.

S. Provide – Furnish, install and connect.

T. PSI – pounds per square inch.

U. Remove – Remove material and equipment and restore surface.

V. UL – Underwriters Laboratories, Inc.

W. UL Listed – Materials or equipment by Underwriters Laboratories and included in the most recent edition of the UL Fire Protection equipment Directory.

1.03 SCOPE OF WORK:

A. Upgrade the existing fire protection system to follow the new architectural upgrade as outlined in the project specifications, including all labor, materials, permit, and shop drawings to furnish and install a complete functional automatic sprinkler system in accordance with NFPA 13, and all the following:

1. Wet pipe automatic sprinkler system thought the building.
2. Any required core drilling of floors and walls, and provide FM approved non-combustible fire stopping materials at all fire protection piping penetrations of fire resistance rated construction. Piping penetrations shall be adequately fire stopped to maintain the fire resistance rating required.
3. Coordinate all work with other trades. During bidding, Contractor shall review his work with other trade to identify any obstructions from beams, ducts, diffusers, lights, structures, etc. Provide cost allowance for piping adjustment, additional piping and sprinklers as required. All changes shall be reflected on shop drawings.
4. Shop drawings.
5. Two (2) sets of operating instructions and valve diagrams.
6. As-built drawings. The Contractor shall provide as-built drawings in Revit and PDF format in addition to required full size reproducible drawings.
7. Contractor shall provide hydraulic calculation if there is any deviation or propose deviation from the approved set as a result of site condition and coordination. No hydraulic calculations were performed during the design phase since the scope includes only sprinkler heads relocation, same elevation, criteria, and existing sprinkler arrangement was considered for the design.
8. On-site project supervision.
9. Cabinet containing the required number and type of spare sprinklers and corresponding wrenches, to be in the riser room.
10. All required system testing in accordance with NFPA 13, 24, 25, and 72.
11. Warranty on all materials and labor.
12. All permits, taxes and fees, including AHJ inspection and testing fees necessary to complete the specified work.

1.04 RELATED WORK:

A. Materials and methods specified in other sections, included but not limited to:

1. Cutting and patching.
2. Fire extinguishers, cabinets, and accessories.
3. Painting of finished surfaces at pipe penetrations by other than Contractor.
4. Grading.

B. Materials furnished and installed in this section but wired by others:

1. Valve supervisory devices shall be furnished and installed the Contractor but wired by the alarm contractor.
2. Water flow switches shall be furnished and installed by the Contractor but wired by the alarm contractor.

1.05 DESIGN CRITERIA

A. Flow Test: If new hydraulic calculations are required, the Contractor must provide a new flow test or flow test data current within 6 months of submittal for review.

B. Contractor shall provide hydraulic calculation if there is any deviation or propose deviation from the approved set as a result of site condition and coordination. No hydraulic calculations were performed during the design phase since the scope includes only sprinkler heads relocation, same elevation, criteria, and existing sprinkler arrangement was considered for the design.

C. If required, this flow test data will be used as basis for Contract Documents. Sprinkler Contractor, prior to preparation of installation design calculations, shall validate this flow data.

D. If required, send hydrant flow test data to Engineer.

E. If required, hydraulically calculated system shall be designed to a minimum of 10% below available water flow curve.

F. If required, systems that are hydraulically calculated must include 1.2 factor for design area.

G. Sprinkler System :

H. Office areas and general building spaces shall be hydraulically designed to provide minimum density of 0.10 gpm per sq ft over most hydraulically remote 1500 sq ft. Maximum spacing shall not exceed 225 sq ft per head.

I. Other mechanical equipment areas shall be hydraulically designed to provide minimum density of 0.15 gpm per sq ft for most remote 1500 sq ft. Maximum spacing shall not exceed 130 sq ft per head.

J. Hose Streams:

1. Add 100 gpm hose stream to light hazard hydraulic calculations.
2. Add 250 gpm hose stream to ordinary hazard hydraulic calculations.

K. Fire Protection System Layout and Shop Drawings:

1. Contractor shall review Design Drawings and Specifications, and shall produce Shop Drawings, calculations, and product data sheets.
2. Conceal sprinkler piping above ceilings where possible.
3. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
4. Submit shop drawings, calculations (when required) and product data sheets for coordination review to: Architect, and Engineer of Record over this Project before installation (see submittals).
5. Contractor shall be held to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
6. Contractor shall coordinate routing of piping with other trades and Architect.
7. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.

1.06 QUALITY ASSURANCE:

A. Codes and Standards:

1. NFPA 13, Installation of Sprinkler Systems
2. NFPA 24, Installation of Private Fire Service Mains
3. NFPA 72, National Fire Alarm Code
4. Underwriters Laboratories (UL) Fire Protection Equipment Directory
5. California Building Code – Latest Adopted Version
6. California Fire Code – Latest Adopted Version
7. Title 19 of California Code of Regulations

B. Contractor Installation Program:

1. Licensed persons employed by Sprinkler Contractor shall perform planning, calculations, layout, and installation. Certified sprinkler designer, National Institute for Certification of Engineering Technologies, (NICET) Level IV or licensed Professional Engineer for planning and calculations, and journeyman sprinkler fitters for installation foreman and supervisory personnel.
2. Journeyman automatic fire sprinkler fitter(s) shall supervise field installation.
3. Contractor shall be licensed in the State of California for Installation of Fire Protection Systems.
4. Contractor shall submit pre-qualification evidence of at least 3 projects of comparable size successfully completed with their Bid.
5. Distortion or misrepresentation of qualification evidence may result in Contract cessation.

C. Electrical Coordination:

1. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for power side or the control of electrical equipment shall be furnished by Division 26 and Division 28 contractors, except as specifically noted elsewhere in this specification.
2. Should any change in electrical equipment size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, sprinkler contractor is to immediately notify Division 26 and Division 28 contractors of this change and pay any costs due to this change.
3. Division 26 contractors shall provide all power wiring and sprinkler contractor shall provide all control wiring and its conduit. Control wiring shall conform to Division 26 and 28 requirements for control wiring.
4. Sprinkler contractor shall provide exterior waterflow alarm and coordinate installation with Division 26 and Division 28 contractors.
5. Furnish wiring diagrams to Division 26 and Division 28 contractors for all equipment and devices furnished by the sprinkler contractor which have been indicated to be wired by the Division 26 and Division 28 contractors.

1.07 APPROVALS

A. P2S Inc. has prepared permit drawings, which have been approved by DSA. The Contractor shall use these drawings to prepare shop drawings to be used in system installation. The Contractor shall submit the shop drawings to the Engineer or Record for approval prior in system installation.

1.08 SUBMITTALS:

A. Contractor shall submit complete system packages. Partial submittals will be rejected.

B. Shop Drawings

1. Contractor shall review Design Drawings and Specifications and shall produce Shop Drawings, calculations and product data sheets.
2. Conceal sprinkler piping above ceilings where possible.
3. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
4. Submit three sets of complete shop drawings, and three sets of manufacturer's data to Architect, Engineer, and other Authorities Having Jurisdiction for all necessary reviews prior to fabrication and installation of materials. Three sets of hydraulic calculations shall be provided if Contractor propose any deviation to the approved set.
5. Hydraulic calculations (when required) shall include a water supply graph and hydraulic cover sheet. The cover sheet shall include the name and location of the calculated area, ceiling height, occupancy, design criteria, sprinkler spacing, system type, sprinkler make, model, size, K-factor and temperature rating, flow requirements, C-factor used, water supply data and source of information.
6. Contractor shall be held to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
7. Contractor shall coordinate routing of piping with other trades and Architect.
8. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.
9. Prepare shop drawings with a minimum scale of 1/8 inch = 1 foot-0 inch for plans, and 1/4 inch = 1 foot-0 inch for details. Show all piping, sprinklers, hangers, type of pipe, tube connections, outlets, type of roof construction, and occupancy of each area, including ceiling and roof heights as required by NFPA 13. When welding is planned, shop drawings shall indicate the sections to be shop welded and the type of welded fittings to be used. All drawings shall be prepared using Revit.
10. Design shall be based on these specifications and the appropriate NFPA standards.
11. Shop drawings shall include details of earthquake sway bracing, including the appropriate calculations.
12. Shop drawings shall include details of underground thrust blocking/restraints.

C. Changes

1. Make no changes in installation from layout as shown on the bridging drawings unless change is specifically approved by the Engineer and DSA. This does not include minor revisions for the purpose of coordination.
2. Any pipe fabricated and/or installed before all approvals are obtained at the Contractor's own expense and responsibility. Any changes made to the approved drawings other than as stated above are at the Contractor's own expense and responsibility.
3. Any CCD's and/or addendums to the DSA approved plans will require the Engineer to make the changes and must be submitted to DSA for plan review. Work on the CCD's and/or addendums shall not start until it is approved by the Architect, Engineer and DSA.

D. Manufacturer's Data

1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. Where any devices that are provided or furnished involve work by someone other than the Contractor, submit additional data copies directly to the Contractor. At a minimum, the following data sheets shall be provided:

    a. Sprinklers and escutcheons.
    b. Pipe, fittings and hangers.

c. Sprinkler Heads.
d. Sprinkler Head Cabinet.
e. Hanger Assemblies
f. Drawings.
g. Fire stopping materials (including installation detail).

2. Include items listed in product section and additional items required to provide complete installation.
3. Indicate by red marking or arrow, items to be used where more than 1 item appears on manufacturer's catalog sheet.
4. Submit shop drawings and equipment submittals to Engineer and Owner's Insurance representative prior to installation or fabrication of system components.
5. Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.

E. As-Built Drawings

1. Maintain at the site an up-to-date marked set of as-built drawings, which shall be corrected and delivered to the Owner upon completion of work.
2. Upon completion, furnish the Owner with 3 sets of reproducible sepia prints, and one set in electronic Revit and PDF format of each reviewed shop drawing, revised to show "as-built" conditions.

F. Final Inspection and Test

1. The Contractor shall make arrangements with the Owner, Owner's commissioning agent, Architect, Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect, and the Engineer will witness the final inspection.
2. Perform all tests and inspections required by the referenced codes and standards, the AHJ, and the Owner.
3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.
4. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate to the Owner, local fire official, Architect and DSA..

G. Operating Instruction

1. Furnish one copy of the latest NFPA 25 CA amended and bound set of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

1.09 SPARE PARTS

A. Provide and install one spare sprinkler cabinet, complete with 12 sprinklers of all types and temperature ratings used throughout the installation. The cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.

B. Confer with the Owner's representative for the exact location of the cabinet.

1.10 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

1.11 PRODUCT DELIVERY

A. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.

B. Storage of Materials, Equipment and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.

C. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.

1.12 QUALITY ASSURANCE

A. Testing Agency: All materials shall be UL listed or FM approved for their intended use.

B. Regulatory Agencies: State and local building codes and ordinances, and fire department requirements shall apply.

C. The Contractor shall be fully experienced and licensed in all aspects of the fire protection systems herein specified.

D. Similar materials shall be from a single manufacturer.

1.13 JOB CONDITIONS

A. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.

B. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.

1.14 EMERGENCY SERVICE

A. The Contractor shall provide emergency repair service for the sprinkler system within four hours of a request for such service by the Owner during the warranty period. This service shall be available on a 24-hour per day, seven-day per week basis.

1.15 TRAINING

A. The Contractor shall conduct two training sessions of four hours each to familiarize the facility personnel with the features, operation and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Owner at a mutually agreeable time to the Contractor and the Owner.

1.16 PERMITS AND FEES

A. Pay for all permits, fees and charges required for this work.

PART 2 - PRODUCTS

2.01 GENERAL

A. All components shall be used in accordance with the manufacturer's recommendations and its UL listing and/or FM approval.

B. The naming of manufacturers in the specifications shall not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.

C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

2.02 MATERIALS

A. Materials and Equipment

1. Materials and equipment in system shall be new and current products of manufacturer regularly engaged in production of such materials and equipment.
2. Where 2 or more pieces of equipment are required to perform interrelated functions, they shall be products of 1 manufacturer.
3. Clean and cap pipe after fabrication and prior to placing pipe in building.
4. Mark pipe with tags that can be removed during installation, so no permanent markings remain on unpainted pipe located in exposed areas.
5. Couplings shall be tees with capped outlets.

B. Approval Guides:

1. Unless otherwise shown, products shall be UL Listed in the latest publication of the UL Fire Protection Equipment Directory or Approved in the latest Factory Mutual Approval Guide for service intended.

2.03 PIPE

A. Above Ground:

1. Sprinkler Piping

a. Carbon steel pipe, Schedule 10, ASTM A795, ASTM A53 or A135, roll-grooved for mechanical fittings.
b. Carbon steel pipe, Schedule 40, ASTM A795, ASTM A53 or A135, cut-grooved for mechanical fittings.
c. Provide metal pipe's exposed threads with corrosion inhibitive paint.

d. Pipe shall be new, rated for 300 psi working pressure, conforming to ASTM specifications, and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.

1) Pipe used shall be black steel and must comply with the specifications of the American Society for Testing and Materials, ASTM A53 for welded and seamless steel pipe.
2) Schedule 40 piping is required for sizes 2 inches and less. Pipe ends shall be threaded or roll grooved in accordance with NFPA 13.
3) Schedule 10 piping shall be provided for sizes 2½ inches and larger. Pipe ends shall be welded or roll grooved in accordance with NFPA 13.
4) Hot-dipped galvanized pipe shall be used when exposed to the outside.
5) Hot-dipped galvanized pipe shall be used for drain pipe.

2.04 FITTINGS AND JOINTS

A. Above Ground:

1. Cast iron threaded, Class 125, 175 psi WOG pressure rating, ANSI B16.4.
2. Cast iron flanged, Class 125, 175 psi WOG pressure rating, ANSI B16.1.
3. Grooved:

a. Ductile iron or malleable iron, grooved for mechanical coupling, 175 psi WOG pressure rating, malleable iron conforming to ASTM A536 for ductile iron and ASTM A47 for malleable iron.
b. Fitting, gasket and coupling shall be furnished by same manufacturer.
c. Acceptable manufacturers: Victaulic, Gruvlok or Viking Corp.
d. Grooved fittings and couplings shall be produced by the same manufacturer.
e. Grooved couplings shall be dimensionally compatible with pipe.

4. Screwed fittings shall be cast iron, 175 pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 175 pound class, black and in accordance with ANSI B 16.3. Bushings shall not be used.
5. Fitting, gasket and coupling shall be furnished by same manufacturer.
6. Galvanized, cast iron, threaded fittings, 175 psi WOG pressure rating, ANSI B16.4.
7. Fittings shall be hot-dipped galvanized when installed on galvanized piping.
8. Weld-o-lets welded to piping in fabrication shops are permitted. No welding allowed at project site.
9. Weld fittings shall be steel, standard weights, black, and in accordance with ASME B 16.9, ASME B 16.25, ASME B 16.5, ASME B 16.11 and ASTM A 234.

2.05 VALVES:

A. Drain Valves:

1. Acceptable manufacturers: Kennedy, Nibco or equal.
2. Thread-in bonnet bronze globe valves, rated to 175 psi non-shock cold water working pressure.
3. Low point drain valves shall have, 3/4" brass nipple with 3/4" male hose threads and cap.

2.06 SPRINKLER HEAD

A. Fire sprinklers installed on wet system shall be of one manufacturer throughout the building. No mixing of sprinkler brands shall be permitted.

B. Manufacturers: Unless otherwise noted below, shall be manufactured by Viking Corp.

C. Automatic, having temperature rating suitable for location.

D. Light Hazard and Ordinary Hazard occupancies shall be Quick Response type sprinkler heads.

E. Architect will review deviations from the specified styles for approval prior to installation.

F. Provide the following type of sprinkler head.

1. In areas with new ceilings.

a. Concealed Pendent, 1/2" orifice, ordinary temperature class (155°F) glass bulb, Viking Mirage QR Concealed Pendent, Model VK462 adjustable sprinkler, with 135°F temperature rated cover plate, flush with ceiling. Cover plate color shall match ceiling color and shall be factory-painted (i.e. by manufacturer).

G. Submit samples for examination and approvals.

H. Sprinkler Cabinets:

1. Complete with required number of spare sprinkler heads of each type and temperature
2. rating and special wrenches per NFPA 13
3. Provide multiple cabinets to meet this requirement.
4. Coordinate cabinet locations with Owner's representative.

2.07 HANGERS

A. Provide hangers to support piping: in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet requirements of NFPA 13.

B. Riser clamps shall not protrude more than 2" beyond edge of hole. Provide Anvil Fig. 261 or equal.

C. Concrete expansion anchors are to be Hilti, Rawl, or Phillips concrete fasteners.

2.08 DIELECTRIC FITTINGS

A. Acceptable manufacturers: Epco Sales, Inc., Lochinvar, Watts Regulator Co., Wilkins or equal.

B. Insulating nipple, metal casing, inert thermoplastic lining, Clearflow dielectric fitting by Perfection Corporation.

C. Dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psig at 180ºF.

2.09 SLEEVES FOR WALL/FLOOR PENETRATIONS

A. Sleeves through walls and floors shall be of a type that can be made watertight and fire stopped.

1. Sleeve sizes shall be as required by NFPA 13 for Earthquake Protection.

2.10 SIGNS

A. Provide standard metal signs in English in accordance with NFPA 13.

B. Provide hydraulic calculation information signs at risers in accordance with NFPA 13.

PART 3 - EXECUTION

3.01 GENERAL

A. Product Delivery

1. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.
2. Storage of Materials, Equipment and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
3. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.

B. Clean-up

1. Maintain the premises free from accumulation of waste materials or rubbish caused by this work.
2. At the completion of the work, removed all surplus materials, tools, etc., and leave the premises clean.

C. Leak Protection

1. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.
2. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the fire protection system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.

D. Safety

1. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.
2. Contractor shall attend all job safety meetings.

3.02 FABRICATION

A. Pipe Ends

1. Ream and remove burrs after cutting pipe. Standard wall pipe ends shall be welded, threaded, cut grooved, or plain end.
2. Thin wall pipe ends shall be plain end, welded or roll grooved in accordance with the fitting manufactures' recommendation.
3. Threads shall be in accordance with ASME B1.20.1. Each thread on light wall pipe shall be gauged before the fitting is made-up.

B. Grooved Ends

1. Pipe minimum thickness, squareness and out-of roundness shall be in accordance with the coupling manufacturers specifications.
2. Pipe surface shall be free of indentations, projections, or roll marks from the end of the pipe to the groove.

C. Welding

1. No field welding of sprinkler piping shall be permitted.
2. Certified records shall be maintained upon the completion of each weld, welder shall stamp an imprint of their identification into the side of the pipe adjacent to the weld.

3.03 INSPECTION

A. Investigate site conditions; verify utility locations and elevations before start of excavation.

B. Discrepancies will be forwarded to Architect/Engineer before proceeding with construction

3.04 INSTALLATION

A. A clean set of prints or shop drawings shall be maintained at the site and marked up to show any changes.

B. Piping shall be installed above ceilings except in areas where there is no ceiling. Install piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.

C. Install pipe and fittings according to recommendations of pipe manufacturer.

D. Keep materials within listed temperature range to assure jointing in accordance with manufacturer's requirements.

E. Pipe and fittings shall be of corresponding materials when assembled.

F. Provide auxiliary drains at low points of systems. Where trapped section of pipe exceeds 5 gallons, drain shall consist of, as a minimum: valve, 3/4" brass nipple with 3/4" male hose threads, and cap.

G. No bushings or grooved reducing couplings, such as Victaulic Style 750, are allowed.

H. Feed sprinkler heads, installed in finished ceilings, with swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases. Sprinklers are required to be installed in the center of ceiling tiles.

I. Provide minimum 1” outlets with sprigs or drops for sprinklers located in shelled spaces.

J. Install sprinkler heads as recommended by manufacturer. Sprinklers shall be set level and at locations to avoid interference with spray pattern of sprinkler. When ducts and lights are obstructions to sprinkler distribution, provide additional heads beneath obstruction.

K. Make joints of threaded pipe by cutting pipe square and reaming inside.

L. Coat exposed threads with corrosion inhibitive paint. Use joint compound sparingly.

M. Install joints for mechanical coupled pipe according to manufacturer's recommendations. Use manufacturer’s gasket lubricant sparingly.

N. Pipe shall be cut grooved for Schedule 40 steel pipe or roll grooved for Schedule 10 steel pipe as specified by coupling manufacturer.

O. Welded joints shall be made in fabrication shop. No welding allowed at project site.

P. Hang pipe from building members using concrete inserts or beam clamps. Expansion type inserts may be used for branch piping.

Q. Support piping in accordance with NFPA 13 Seismic Anchorage and Restraints, and in accordance with State and Local seismic restraint requirements.

R. Generally install capped tees in lieu of couplings for future connections.

3.05 SPRINKLERS

A. General

1. Sprinklers below ceilings off of exposed piping shall be listed and approved regular bronze upright type, in upright position. Listed and approved regular bronze pendent type may be used where necessary due to clear height requirements, duct interference, etc.
2. Pendent sprinklers shall be installed where suspended ceilings are located shall be concealed type and center of tile.
3. Sprig-ups shall be provided wherever necessary to provide proper deflector distances in accordance with NFPA 13 requirements.
4. Provide sprinkler below duct with minimum width 4 ft and above.

B. Sprinkler Guards and Water Shields

1. Provide guards on sprinklers within 7 feet of finished floor or wherever sprinklers may be subject to mechanical damage.

C. Drains

1. Provide all auxiliary drains where necessary.
2. Pipe all drains and auxiliary drains to locations where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.
3. Plugs used for auxiliary drains shall be brass.
4. All piping and fittings downstream of drain valve and gang drain shall be hotdipped galvanized.
5. The Contractor shall comply with all water discharge restrictions.

3.06 VALVES

A. General

1. Valves shall be installed with sufficient clearance for operation, testing and maintenance.
2. Where wafer bodied valves are used, they shall be installed so that the discs do not interfere with other components.

3.07 HANGERS, SUPPORTS,

A. General

1. All piping must be substantially supported from building structure and only approved types of hangers shall be used. Piping lines under ducts shall not be supported from duct work, but hall be supported from building structure with trapeze hangers where necessary or from steel angles supporting duct work in accordance with NFPA 13.
2. All thread rods shall not be bent.
3. Hanger components shall be ferrous.
4. Powder driven studs shall be specifically listed for use in the required seismic zone.

B. Feed and Cross Mains

1. Install at least one hanger per length of pipe up to 8 feet in length joined by grooved couplings.
2. Use flexible couplings where more than two couplings are used per run.

3.08 SLEEVINGS, WALL AND FLOOR PENETRATIONS

A. Set Schedule 40 sleeves in place for all pipes passing through openings in fire resistance rated construction when required by UL listing for fire stopping method utilized.

B. Provide clearance between the sprinkler piping and sleeves in accordance with NFPA and FM. The space between sleeve and pipe shall be filled with noncombustible, UL listed fire stopping materials. Provide chrome wall plates at each side of wall.

C. Sleeves through floors shall be watertight. Penetrations through fire rated construction shall be adequately fire stopped to maintain the fire resistance rating required.

3.09 SIGNS

A. Valves

1. Secure to each valve with corrosion resistant wire or chain, sign stating, “Control valve.”

3.10 SYSTEM ACCEPTANCE

A. Tests

1. General system test shall be coordinated with the Owner’s representatives for training and witnessed by the AHJ and Owner’s commissioning agent. Problems noted during testing such as air or water leaks, difficulty in operating valves, alarm failures, etc. shall be corrected before the Contractor leaves the job.
2. Hydrostatically test all piping, including fire department connections between the check valve and connection, at 200 psi for two hours. If the highest static pressure at the lowest point in the system exceeds 150 psi, the system shall be tested at 50 psi more than the highest static pressure. Modifications that cannot be isolated, such as relocated drops, shall require testing at system working pressure.
3. Flow Tests

    a. Main drain shall be opened wide until pressure stabilizes then slowly closed, noting and recording flowing (residual) and static (non-flow) pressure.
    b. Pressure-reducing floor control valves and fire hose valves shall be tested noting inlet and outlet pressures under non-flowing and flowing conditions. Record results.
    c. Pilot-operated pressure-reducing valves shall be tested as specified in (b). Adjust pilot for design pressures.
    d. Backflow preventers shall be forward-flow tested.

4. Pipe shall not be concealed until satisfactorily pressure tested.
5. Conduct drain test. Record static pressure and residual pressure per NFPA 13.
6. Owner's representative or engineer may witness tests. Contractor shall notify Owner and Engineer a minimum of 3 days in advance to allow for participation.
7. Log of tests shall be kept at job site and shall identify:

    a. Who performed test.
    b. Time of test.
    c. Date of test.
    d. Section of system tested.
    e. Results of test.
    f. Along with completed Contractor's Material and Test Certification form(s) from NFPA 13 and NFPA 14.

B. Training

1. General – In addition to the tests required in Parts A through C and witnessed by the Owner's representative(s), conduct one/two hour training sessions to familiarize the representatives with all operating features of the system, including control valve, drain and test valve locations and operations.
2. Provide Owner's representatives with:

    a. A small scale plan of the system/building showing locations of control, drain and test valves.
    b. Component manufacturers' inspection and testing manuals.
    c. Two copies of NFPA 25.

3. Spare Parts

    a. Provide 12 spare sprinklers of all types and ratings that are installed, in a steel cabinet complete with special sprinkler wrenches. Install cabinet as directed by Owner.

3.11 ADJUSTMENT AND CLEANING

A. Cleaning: Flush all piping in accordance with NFPA Standards for test procedures.

B. Ensure underground feed pipe has been flushed, to clear out construction debris, prior to connecting aboveground fire protection system to it.

C. Maintain the premises free from accumulation of waste materials or rubbish caused by this work

3.12 BONDING

A. Provide underground cast iron and underground ductile iron pipe with metallic bond at each joint.

B. Bond wire shall be type RHW-USE size 1/0 neoprene-jacketed copper conductor shaped to stand clear of joint.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 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.
6. Grout.
7. Plumbing demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.02 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, crawlspaces, 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.

1.03 SUBMITTALS

1.04 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

2.01 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.

2.02 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.

F. Welding Filler Metals: Comply with AWS D10.12.

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.

2.03 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).

2.04 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.

2.05 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.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.06 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.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PLUMBING DEMOLITION

A. Refer to Division 01 Section “Cutting and Patching” 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 the AHJ.

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.

3.02 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.

3.03 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.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

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 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

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.

3.04 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.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 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.

3.06 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."

3.07 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.

3.08 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

SECTION 22 05 16

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

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.

1.02 SUMMARY

A. Section Includes:

1. Rubber union connector packless expansion joints.
2. Flexible-hose packless expansion joints.
3. Metal-bellows packless expansion joints.
4. Externally pressurized metal-bellows packless expansion joints.
5. Rubber packless expansion joints.
6. Grooved-joint expansion joints.
7. Alignment guides and anchors.
8. Pipe loops and swing connections.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.02 PACKLESS EXPANSION JOINTS

A. Rubber Union Connector Expansion Joints RUEJ-01:

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. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Mason Industries, Inc.
    d. Unisource Manufacturing, Inc.

2. Material: Twin reinforced-rubber spheres with external restraining cables.

3. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.
4. End Connections for NPS 2 and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints FHEJ-01:

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. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Mason Industries, Inc.
    d. Metraflex Company (The).

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.

3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

    a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
    b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg Fand 315 psig at 450 deg Fratings.

6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged or welded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged or welded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

9. Expansion Joints for Steel Piping NPS 14 and Larger: Carbon-steel fittings with flanged or welded end connections.

    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg Fand 120 psig at 600 deg F ratings.

C. Metal-Bellows Packless Expansion Joints MBEJ-01:

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. Expansion Joint Systems, Inc.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Mason Industries, Inc.
e. Metraflex Company (The).

2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 150 psig to 200 psig, unless otherwise indicated.
5. Configuration: Single joint with base or double joint with base class(es), unless otherwise indicated.
6. Expansion Joints for Copper Tubing: Single- or multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

7. Expansion Joints for Steel Piping: Single- or multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged or Welded.

D. Externally Pressurized Metal-Bellows Packless Expansion Joints EPEJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex-Hose Co., Inc.
b. Mason Industries, Inc.
c. Metraflex Company (The).
d. U.S. Bellows, Inc.

2. Minimum Pressure Rating: 150 psig, unless otherwise indicated.

3. Description:

a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
b. Carbon-steel housing.
c. Drain plugs and lifting lug for NPS 3 and larger.
d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
f. Joint Axial Movement: 4 inches, 6 inches, 8 inches of compression and 0.75 inch, 1 inch, 2 inches of extension as required.

4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
5. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

E. Rubber Packless Expansion Joints REJ-01:

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. Flex-Hose Co., Inc.
   b. Mason Industries, Inc.
   c. Metraflex Company (The).
   d. Unaflex.

2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

3. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
4. Arch Type: Single or multiple arches with external control rods.
5. Spherical Type: Single or multiple spheres with external control rods.
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psigat 220 deg F.
7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psigat 200 deg F.
8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
9. Material for Fluids Containing Acids, Alkalis, or Chemicals: Butyl rubber, Chlorosulfonyl-polyethylene rubber or Ethylene-propylene-diene terpolymer rubber.
10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N or Chlorosulfonated polyethylene synthetic rubber.
11. Material for Water: Butyl rubber, Buna-N, Chlorosulfonated polyethylene synthetic rubber, Chlorosulfonyl-polyethylene rubber, Ethylene-propylene-diene terpolymer rubber or Natural rubber.
12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.03 GROOVED-JOINT EXPANSION JOINTS

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. Anvil International.
2. Shurjoint Piping Products USA Inc.
3. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Five to twelve, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water, Ethylene-propylene-diene terpolymer rubber gasket suitable for cold and hot water, and bolts and nuts.

2.04 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides AG-01:

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. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Flex-Weld, Inc.
    d. Mason Industries, Inc.
    e. U.S. Bellows, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.01 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-PSJ-703.

D. Install grooved-joint expansion joints to grooved-end steel piping.

3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one or two guides on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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.

1.02 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.01 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.

2.02 STACK-SLEEVE 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. Jay R. Smith Mfg. Co.
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.

2.03 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.

2.04 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.

2.05 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.06 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:

    a. May National Associates, Inc.; a subsidiary of Sika Corporation.

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

3.01 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."

3.02 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."

3.03 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.

3.04 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.

3.05 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.

3.06 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

SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

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.

1.02 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.03 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.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 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.
3. Keeney Manufacturing Company (The).
4. ProFlo; a Ferguson Enterprises, Inc. brand.

2.02 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.

2.03 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 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.

3.02 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

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Dial-type pressure gages.
6. Gage attachments.
7. Test plugs.
8. Test-plug kits.
9. Sight flow indicators.

B. Related Requirements:

1. Section 221119 “Domestic Water Piping Specialties” for water meters.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 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.

B. Standard: ASME B40.200.

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.

2.02 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.
b. Palmer Wahl Instrumentation Group.
c. Trerice, H. O. Co.
d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

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.
7. Pointer: Dark-colored metal.
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.

2.03 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.

2. Standard: ASME B40.200.

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.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.04 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
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.

2.05 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:

    a. Ametek U.S. Gauge.
    b. Ashcroft Inc.
    c. Trerice, H. O. Co.
    d. Weiss Instruments, Inc.

2. Standard: ASME B40.100.

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.
8. Pointer: Dark-colored metal.
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.

2.06 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.

2.07 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.

2.08 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.

2.09 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

3.01 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.

3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 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.
3. Metal or Plastic case, compact-style, liquid-in-glass 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.
3. Metal or Plastic case, compact-style, liquid-in-glass 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.
3. Metal or Plastic case, compact-style, liquid-in-glass 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.

3.05 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.

3.06 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.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping: 0 to 200 psi.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

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.

1.02 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Bronze gate valves.
6. Iron, single-flange butterfly valves.
7. Iron, grooved-end butterfly valves.
8. Chainwheels.

1.03 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.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61and NSF 372.

1.05 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

2.01 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.
5. ASME B16.18 for solder-joint connections.
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.

2.02 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:

a. Standard: MSS SP-110.
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.
i. 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:

a. Standard: MSS SP-110.
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. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Description:

a. Standard: MSS SP-110.
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:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three 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.

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:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
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.

2.03 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:

   a. Standard: MSS SP-110.
   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:

   a. Standard: MSS SP-110.
   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.
c. NIBCO INC.
d. WATTS.

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.
f. Press Ends Connections Rating: Minimum 200 psig.
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:

a. Standard: MSS SP-110.
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:

a. Standard: MSS SP-110.
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:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
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:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
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:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece
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:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
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:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze, ASTM B 584, Alloy C844.

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.

2.04 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.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
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.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: NBR, PTFE.

2.05 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.
    d. Body Material: ASTM B 62, bronze.
    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.
    d. Body Material: ASTM B 62, bronze.
    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.

d. Body Material: ASTM B 62, bronze.
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.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

2.06 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.
c. Body Material: Bronze with integral seat and screw-in bonnet.
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.
c. Body Material: Bronze with integral seat and screw-in bonnet.
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.
c. Body Material: Bronze with integral seat and union-ring bonnet.
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.
c. Body Material: Bronze with integral seat and union-ring bonnet.

d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.07 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. <Double click here to find, evaluate, and insert list of manufacturers and products.>

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. Apollo Flow Controls; Conbraco Industries, Inc.
    b. KITZ Corporation.
    c. Milwaukee Valve Company.
    d. NIBCO INC.

3. 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.

2.08 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.
    d. Stem: Two-piece stainless steel.
    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.

2.09 CHAINWHEELS

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. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.

1. Sprocket Rim with Chain Guides: Ductile or cast iron, Aluminum or Bronze, of type and size required for valve. Include zinc or epoxy coating.
2. Chain: Hot-dip, galvanized steel, Brass or Stainless steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 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.

3.05 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valves, one piece.
3. Bronze ball valves, one piece with bronze or stainless steel trim.
4. Brass ball valves, two-piece with full-port and brass or stainless steel trim.
5. Bronze ball valves, two-piece with full-port and bronze, brass or stainless steel trim.
6. Brass ball valves, three-piece with full port and brass or stainless steel trim.
7. Bronze ball valve, three-piece with full port and bronze, brass or stainless steel trim.
8. Bronze ball valves, two-piece with regular port and bronze or stainless steel trim.
9. Vertical, Upflow Applications Only: Bronze lift check valves with bronze disc, Class 125, with soldered or threaded end connections.
10. Horizontal and Vertical Applications: Bronze swing check valves with bronze disc, Class 125 or Class 150, with soldered or threaded end connections.
11. 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, grooved-end swing check valves, 300 CWP.
6. Iron, dual-plate check valves with metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.
7. Iron, single-plate check valves with resilient seat, Class 125 or Class 250, with threaded or flanged end connections.
8. Iron gate valves, NRS, OS&Y, Class 125 or Class 150 with flanged ends.
9. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
10. Ductile-Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.

3.06 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve.
3. Bronze ball valve, one piece with bronze or stainless steel trim.
4. Brass ball valves, two-piece with full-port and brass or stainless steel trim.
5. Bronze ball valves, two-piece with full-port and bronze, brass or stainless steel trim.
6. Brass ball valves, three-piece with full port and brass or stainless steel trim.
7. Bronze ball valves, three-piece with full port and bronze, brass or stainless steel trim.

8. Bronze ball valves, two-piece with regular port and bronze or stainless steel trim.
9. Vertical, Upflow Applications Only: Bronze lift check valves with bronze disc, Class 125, with soldered or threaded end connections.
10. Horizontal and Vertical Applications: Bronze swing check valves with bronze disc, Class 125 or Class 150, with soldered or threaded end connections.
11. 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, grooved-end swing check valves, 300 CWP with threaded or flanged end connections.
6. Iron, dual-plate check valves with metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.
7. Iron, single-plate check valves with resilient seat, Class 125 or Class 250, with threaded or flanged end connections.
8. Iron gate valves, NRS, OS&Y, Class 125 or Class 250 with flanged ends.
9. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
10. Ductile-Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.

3.07 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.
12. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
13. Ductile-Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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.

1.02 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 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 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.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.05 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

2.01 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.

2.02 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.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

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.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

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.

2.03 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.

2.04 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.

3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
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.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
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.

3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
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.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
8. Metallic Coating: Pregalvanized G90 or Hot-dip galvanized.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

2.05 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.

2.06 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.

3. Outdoor Applications: Stainless steel.

2.07 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.
4. Accessories: Protection pads.

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.
7. Accessories: Protection pads.

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, galvanized-steel rod or continuous-thread, stainless-steel 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.

2.08 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.

2.09 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.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 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.

3.02 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.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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.

3.03 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.

3.04 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.

3.05 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.

3.06 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.

3.07 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F. pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. 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.
4. 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.

5. 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.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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.
15. 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.
16. 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.
17. 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.
18. 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.
19. 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.
20. 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.
21. 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

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

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.

1.02 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.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.

1.03 DEFINITIONS

A. CBC: California Buiilding Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.04 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 ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.05 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.

1.06 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 CBC 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 from OSHPD, preapproval by ICC-ES, 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

2.01 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the CBC: A, B, C, D, E or F.
2. Assigned Seismic Use Group or Building Category as Defined in the CBC: 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.

2.02 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.

2.03 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.

2.04 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.

2.05 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.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.06 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.

2.07 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.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.08 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.

2.09 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 RESTRAINT 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 RESTRAINT 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-RESTRAINT ACCESSORIES

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.
3. Kinetics Noise Control, 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

3.01 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.

3.02 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.

3.03 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 ICC-ES, OSHPD 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 ICC-ES, OSHPD 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.

3.04 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.

3.05 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.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
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.
6. Measure isolator restraint clearance.
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.

3.06 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

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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.

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.03 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

2.01 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.
3. Letter Color: White.
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.

3. Letter Color: White.
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.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
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.

2.02 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 Sevices 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.

C. Letter Color: White.

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.

2.03 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.
3. Kolbi Pipe Marker Co.
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.

2.04 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, alkyd 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, alkyd enamel or acrylic enamel paint type in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.05 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.
3. Kolbi Pipe Marker Co.
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.

2.06 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.
3. Kolbi Pipe Marker Co.
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."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099100 "Painting."

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.
2. Stencil Paint: Use for pipe marking.

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.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

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. Low-Pressure Compressed Air Piping:

   a. Background: Safety blue.
   b. Letter Colors: White.

2. High-Pressure Compressed Air Piping:

   a. Background: Safety blue.
   b. Letter Colors: White.

3. Domestic COLD Water Piping

   a. Background: Safety blue.
   b. Letter Colors: White.

4. Domestic HOT Water Supply/Return Piping

   a. Background: Safety red.
   b. Letter Colors: White.

5. Natural Gas Piping

   a. Background: Safety yellow.
   b. Letter Colors: Black.

6. Sanitary Waste, Vent and Storm Drainage Piping:

a. Background Color: Safety green.
b. Letter Color: White.

3.05 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.
c. Low-Pressure Compressed Air: 1-1/2 inches to 2 inches, round.
d. High-Pressure Compressed Air: 1-1/2 inches to 2 inches, round.

2. Valve-Tag Colors:

a. Domestic Water: Natural.
b. Natural Gas: Natural.
c. Low-Pressure Compressed Air: Natural.
d. High-Pressure Compressed Air: Natural.

3. Letter Colors:

a. Domestic Water: Black.
b. Natural Gas: Black.
c. Low-Pressure Compressed Air: Black.
d. High-Pressure Compressed Air: Black.

3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

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.

1.02 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.

1.03 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.

1.04 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.

1.05 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 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.

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. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 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.

1.07 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.

1.08 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

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

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. 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.

H. 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.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

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.

2.03 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:

a. Foster Brand; H. B. Fuller Construction Products.

C. 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.

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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. 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.

2.04 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.
5. Color: White.

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.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

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.
5. Color: White.

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.
5. Color: White.

2.05 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.
5. Color: White.

2.06 SEALANTS

A. Joint Sealants for Cellular-Glass 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.
5. Color: White.

2.07 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.

2.08 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.

2.09 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.
    b. Ideal Tape Co., Inc., an American Biltrite Company.
    c. Knauf Insulation.
    d. Venture Tape.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
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.
    b. Ideal Tape Co., Inc., an American Biltrite Company.
    c. Knauf Insulation.
    d. Venture Tape.

2. Width: 3 inches.

3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
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.
   b. Ideal Tape Co., Inc., an American Biltrite Company.
   c. Venture Tape.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
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:

   a. C & F Wire.

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

3.01 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.

3.02 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.

3.03 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 retarders, 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.
4. Cleanouts.

3.04 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."

3.05 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.

3.06 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.

3.07 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.

3.08 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.

3.09 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099100 " 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.

    a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.10 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."

3.11 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.

3.12 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:

    a. Cellular Glass: 1-1/2 inches thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 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. 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:

a. Cellular Glass: 1-1/2 inches thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.13 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.

3.14 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 22 10 23

FACILITY NATURAL-GAS PIPING

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.

1.02 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Service meters.
7. Dielectric fittings.

1.03 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.

1.04 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.

1.05 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.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves, pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.07 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 CEC, by a qualified testing agency, and marked for intended location and application.

1.08 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.

1.09 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

2.01 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.

2.02 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
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:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    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.

2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.

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.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
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.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

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 2and 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.

2.03 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.

6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

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.
4. CWP Rating: 125 psig.

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.
4. CWP Rating: 125 psig.

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.

2.04 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

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.

2.05 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.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inchand smaller.
6. Service Mark: Valves 1-1/4 inchesto NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
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.

2. Body: Bronze, complying with ASTM B 584.

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.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
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.

2. Body: Bronze, complying with ASTM B 584.
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.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
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.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1and 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.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1and 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.

H. Cast-Iron, Nonlubricated 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. 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.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1and 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.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
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.
4. Stem: Acetal.
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.

2.06 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.

3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
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.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line 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.
e. Maxitrol Company.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
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.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 10 psig.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

2.07 SERVICE METERS

A. Diaphragm-Type Service Meters: Comply with ANSI B109.1, ANSI B109.2.

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.

2. Case: Die-cast aluminum.

3. Connections: Steel threads.
4. Diaphragm: Synthetic fabric.
5. Diaphragm Support Bearings: Self-lubricating.
6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet.
8. Meter Case and Index: Tamper resistant.
9. Remote meter reader compatible.
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.

2. Case: Extruded aluminum.
3. Connection: Flange.
4. Impellers: Polished aluminum.

5. Rotor Bearings: Self-lubricating.
6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet.
8. Tamper resistant.
9. Remote meter reader compatible.
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:

    a. Lyall, R. W. & Company, Inc.
    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.

2.08 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:

a. Standard: ASSE 1079.
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:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Matco-Norca.
d. WATTS.

2. Description:

a. Standard: ASSE 1079.
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.
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.

2.09 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

3.01 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.

3.02 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.

3.03 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."

3.04 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."

3.05 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.

3.06 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 anode for metallic valves in underground PE piping.

3.07 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:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
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.

3.08 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 1and 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.

3.09 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 CEC.

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 099100 "Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    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, 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.
    b. Intermediate Coat: Interior latex matching topcoat.
    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.
    b. Intermediate Coat: Interior alkyd matching topcoat.
    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 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.

3.15 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.

3.16 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. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. 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.

3.17 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG

A. Aboveground Piping: Maximum operating pressure more than 5 psig.

B. Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.

C. Aboveground, distribution piping shall be the following:

1. Steel pipe with steel welding fittings and welded joints.

D. 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.

E. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

F. 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 2and 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.
3. Bronze plug valve.

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.
3. Bronze plug valve.

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.
3. Bronze plug valve.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING AND FITTINGS

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.

1.02 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.

1.03 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.04 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.05 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

2.01 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.

2.02 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.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
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.

2.03 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.

2.04 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.

2.05 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.06 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.
b. Jay R. Smith Mfg. Co.
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:

a. Charlotte Pipe and Foundry Company.
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.

2.07 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. Wilkins.

2. Standard: ASSE 1079.

3. Pressure Rating: 125 psig minimum at 180 deg F.
4. 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:

   a. Central Plastics Company.
   b. Matco-Norca.
   c. WATTS.
   d. Wilkins.

2. Standard: ASSE 1079.

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.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

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.
2. Standard: IAPMO PS 66.
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.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.02 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 thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

U. 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."

V. 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."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.03 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.

3.04 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.

3.05 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.

3.06 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.

3.07 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.

3.08 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.

3.09 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.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
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

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.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated or Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

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

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose bibbs.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer valves.
12. Trap-seal primer systems.
13. Flexible connectors.
14. Water meters.

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.

1.03 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.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 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.

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 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.

2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
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.

2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
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.

2. Standard: ASSE 1020.

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.

2.04 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

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. Standard: ASSE 1013.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 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. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

11. Configuration: Designed for horizontal, straight-through or vertical-inlet, horizontal-center-section, and vertical-outlet flow.
12. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:

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. Standard: ASSE 1015.

3. Operation: Continuous-pressure applications unless otherwise indicated.
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. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-through flow.
12. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Dual-Check-Valve Backflow Preventers:

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. Standard: ASSE 1024.

3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2, NPS 3/4, NPS 1 or NPS 1-1/4.
5. Body: Bronze with union inlet.

2.05 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.

2. Standard: ASSE 1003.

3. Pressure Rating: Initial working pressure of 150 psig.
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.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control 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. CLA-VAL Automatic Control Valves.
    c. WATTS.
    d. Zurn Industries, LLC.

2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.

3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

    a. Size: Refer to Plumbing design drawings.
    b. Pattern: Angle or Globe-valve design.
    c. Trim: Stainless steel.

5. Design Flow: 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. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
9. 7

2.06 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:

    a. Armstrong International, Inc.
    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:

    a. Armstrong International, Inc.
    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.
10. Handle: Vinyl-covered steel with memory-setting device.

2.07 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing 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. Lawler Manufacturing Company, Inc.
    b. Leonard Valve Company.
    c. POWERS; A WATTS Brand.
    d. Symmons Industries, Inc.

2. Standard: ASSE 1017.

3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted or Cabinet-type, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: Refer to Plumbing design drawings.
9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
10. Selected Valve Flow Rate at 45-psig Pressure Drop: Refer to Plumbing design drawings.
11. Pressure Drop at Design Flow Rate: Refer to Plumbing design drawings.
12. Valve Finish: Polished, chrome plated or Rough bronze.
13. Piping Finish: Chrome plated or Copper.
14. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Water Tempering 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. Lawler Manufacturing Company, Inc.
    c. Leonard Valve Company.
    d. POWERS; A WATTS Brand.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.

3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.

7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: Refer to Plumbing design drawings.
9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.

C. Primary Water Tempering 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. Heat-Timer Corporation.
   b. Holby Valve Inc.
   c. Uponor.

2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.

3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze.
5. Temperature Control: Manual.
6. Inlets and Outlet: Threaded.
7. Selected Primary Water Tempering Valve Size: Refer to Plumbing design drawings.
8. Tempered-Water Setting: Refer to Plumbing design drawings.
9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
10. Pressure Drop at Design Flow Rate: Refer to Plumbing design drawings.
11. Tempered-Water Outlet Size: Refer to Plumbing design drawings.
12. Cold-Water Inlet Size: Refer to Plumbing design drawings.
13. Hot-Water Inlet Size: Refer to Plumbing design drawings.
14. Valve Finish: Rough bronze.

2.08 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.

6. Drain: Pipe plug and Factory-installed, hose-end drain valve.

2.09 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.

2. Mounting: Recessed.

3. Material and Finish: Enameled-steel, epoxy-painted-steel or Stainless-steel box and faceplate.
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.

2.10 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.
    b. Jay R. Smith Mfg. Co.
    c. Woodford Manufacturing Company.
    d. Zurn Industries, LLC.

2. Standard: ASME A112.18.1 for sediment faucets.

3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
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.
14. Operation for Finished Rooms: 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.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
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.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

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. MIFAB, Inc.
   b. Precision Plumbing Products.
   c. Sioux Chief Manufacturing Company, Inc.
   d. WATTS.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

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. Jay R. Smith Mfg. Co.
    b. MIFAB, Inc.
    c. Precision Plumbing Products.
    d. WATTS.

2. Standard: ASSE 1018.

3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

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. Jay R. Smith Mfg. Co.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.

3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.14 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer 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. Precision Plumbing Products.
    b. Zurn Industries, LLC.

2. Standard: ASSE 1044.

3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed or Surface-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

    a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Refer to Plumbing design drawings.
8. Size Outlets: NPS 1/2 or NPS 5/8.

2.15 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.

2.16 WATER METERS

A. Displacement-Type Water 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. AALIANT.
    b. ABB.
    c. Mueller Co.
    d. Sensus.

2. Standard: AWWA C700.

3. Pressure Rating: 150-psig working pressure.
4. Body Design: Nutating disc; totalization meter.
5. Registration: In gallons or cubic feet as required by utility company.
6. Case: Bronze.
7. End Connections: Threaded.

B. Turbine-Type Water 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. Badger Industries, Inc.
    b. Hays Fluid Controls.
    c. Master Meter, Inc.
    d. Sensus.

2. Standard: AWWA C701.

3. Pressure Rating: 150 psig working pressure.
4. Body Design: Turbine; totalization meter.
5. Registration: In gallons or cubic feet as required by utility company.
6. Case: Bronze.
7. End Connections for Meters NPS 2 and Smaller: Threaded.
8. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

C. Compound-Type Water 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. Badger Industries, Inc.
    b. Master Meter, Inc.
    c. Mueller Co.
    d. Sensus.

2. Standard: AWWA C702.

3. Pressure Rating: 150-psig working pressure.
4. Body Design: With integral mainline and bypass meters; totalization meter.
5. Registration: In gallons or cubic feet as required by utility company.
6. Case: Bronze.
7. Pipe Connections: Flanged.

D. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.01 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 is 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.

K. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

L. Trap-Seal Primer Systems: 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 system for proper flow.

3.02 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."

3.03 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. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Dual-check-valve backflow preventers.
6. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
7. Double-check, detector-assembly backflow preventers.
8. Water pressure-reducing valves.
9. Automatic water shutoff valves.
10. Calibrated balancing valves.
11. Primary, thermostatic, water mixing valves.
12. Primary water tempering valves.
13. Outlet boxes.
14. Supply-type, trap-seal primer valves.
15. 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."

3.04 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.

3.05 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

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

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.

1.02 SUMMARY

A. Section Includes:

1. Ductile-iron pipe and fittings.
2. Copper tube and fittings.
3. ABS pipe and fittings.
4. PVC pipe and fittings.
5. Specialty pipe fittings.
6. Encasement for underground metal piping.

1.03 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.

1.04 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.

1.05 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

2.01 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
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.

2.02 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.

2.03 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.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Grooved-Joint Piping: AWWA C151/A21.51, with round-cut-grooved ends according to AWWA C606.

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.

2. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings, with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings, and complying with AWWA C606 for grooved ends.
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.

2.04 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:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
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.

2.05 ABS PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement: ASTM D 2235.

1. Solvent cement shall have a VOC content of 325 g/L or less.
2. Solvent cement 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."

2.06 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less.
2. Adhesive primer 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."

E. Solvent Cement: ASTM D 2564.

1. Solvent cement shall have a VOC content of 510 g/L or less.

2.07 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:

1) Dallas Specialty & Mfg. Co.
2) Fernco Inc.
3) Mission Rubber Company, LLC; a division of MCP Industries.
4) Plastic Oddities.

b. Standard: ASTM C 1173.

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:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
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:

      1) Cascade Waterworks Mfg. Co.
      2) Mission Rubber Company, LLC; a division of MCP Industries.

   b. Standard: ASTM C 1460.
   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:

      1) Cascade Waterworks Mfg. Co.
      2) EBAA Iron, Inc.
      3) Jay R. Smith Mfg. Co.
      4) JCM Industries, Inc.

   b. Standard: AWWA C219.
   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.

2.08 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

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.02 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.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
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:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
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."

AA. Condensate Drain Trap: provide take-down unions on inlet and outlet sides of Condensate drain traps.

3.03 JOINT CONSTRUCTION

A. 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.

B. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

C. 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.

D. 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.

E. 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.

3.04 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.
3. In Aboveground Force Main Piping: Fitting-type 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.

3.05 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."

3.06 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 supports for vertical steel piping every 15 feet.

G. 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.

H. Install supports for vertical stainless-steel piping every 10 feet.

I. 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.

J. Install supports for vertical copper tubing every 10 feet.

K. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.07 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.

3.08 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."

3.09 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. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Stainless-steel pipe and fittings gaskets, and gasketed joints.
2. 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.

3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 and larger shall be any of the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
2. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

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

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

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.

1.02 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Roof flashing assemblies.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Floor drains.

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.

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.
2. Wiring Diagrams: Power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 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 CEC, 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.

2.02 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:

    a. Jay R. Smith Mfg. Co.
    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 or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Stainless-Steel 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:

    a. BLÜCHER; A Watts brand.

b. Josam Company.
c. WATTS.

2. Standard: ASME A112.3.1.

3. Size: Same as connected drainage piping
4. Body Material: Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Stainless-steel plug with seal.

C. 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:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. WATTS.
d. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing or threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing or Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: As Required.
7. Outlet Connection: Inside calk, Spigot or Threaded.
8. Closure: Brass plug with straight threads and gasket or Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads or setscrews.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Polished bronze or Rough bronze.
11. Frame and Cover Shape: Round. Square when specifically requested by owner.
12. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
13. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Stainless-Steel 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:

a. BLÜCHER; A Watts brand.
b. Josam Company.
c. Kusel Equipment Co.
d. WATTS.

2. Standard: ASME A112.3.1.
3. Size: Same as connected branch.
4. Housing: Stainless steel.
5. Closure: Stainless steel with seal.

6. Riser: ASTM A 74, Extra-Heavy or Service class, stainless-steel drainage pipe fitting and riser to cleanout.
7. Body or Ferrule: Stainless steel.
8. Clamping Device: As Required.
9. Outlet Connection: Inside calk, Spigot or Threaded.
10. Closure: Brass plug with straight threads and gasket or Brass plug with tapered threads.
11. Adjustable Housing Material: Cast iron with threads or setscrews.
12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy or Stainless steel.
13. Frame and Cover Shape: Round. Square when specifically requested by owner.
14. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.

E. 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:

   a. Jay R. Smith Mfg. Co.
   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: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:

   a. Brass or Cast iron.
   b. Countersunk or raised head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.03 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

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 Engineering Company.
   b. Thaler Metal Industries Ltd.
   c. Zurn Industries, LLC.

2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch or 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

a. Open-Top Vent Cap: Without cap.
b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.04 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.05 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch-minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. 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.

D. 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.

E. 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.

F. Stack Flashing Fittings:

1. Description: Counterflashing-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.

G. 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.

H. Expansion Joints:

1. Standard: ASME A112.6.4.
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.
5. Maximum Overcurrent Protection: <Insert number> A.

2.06 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:

   a. Jay R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. Wade; a subsidiary of McWane Inc.
   d. WATTS.

2. Standard: ASME A112.6.3 with backwater valve where required.
3. Pattern: Area or Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: As Required.
6. Anchor Flange: As Required.
7. Clamping Device: As Required.
8. Outlet: Bottom.

9. Backwater Valve: Drain-outlet type or Integral, ASME A112.14.1, swing-check type.
10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
11. Sediment Bucket: As Required.
12. Top or Strainer Material: Nickel bronze or Stainless steel.
13. Top of Body and Strainer Finish: Nickel bronze or Stainless steel.
14. Top Shape: Round. Square when specifically requested by owner.
15. Dimensions of Top or Strainer: Refer to Plumbing Fixture Schedule on Construction Plans for body, sump, and grate requirements.
16. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
17. Funnel: Not required.
18. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
19. Trap Material: Bronze, Cast iron or Copper.
20. Trap Pattern: Deep-seal P-trap or Standard P-trap.
21. Trap Features: Trap-seal primer valve drain connection.

PART 3 - EXECUTION

3.01 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."
2. Comply with requirements for vibration-isolation devices specified in Section 220548.13 "Vibration 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.

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. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

H. Assemble open drain fittings and install with top of hub 1 inch or 2 inches above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. 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.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. 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.

R. Install trench drains at low points of surface areas to be drained.

1. Set grates of drains flush with finished surface, unless otherwise indicated.

S. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.

1. Install on support devices, so that top will be flush with adjacent surface.

T. Install open drain fittings with top of hub 1 inch2 inches above floor.

3.02 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.

3.03 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.

3.04 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."

3.05 FIELD QUALITY CONTROL

A. 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.

3.06 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

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

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.

1.02 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.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 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:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.

d. WATTS.

2. Standard: ASME A112.6.4.

3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-to 16-inch diameter.
5. Combination Flashing Ring and Gravel Stop: As Required.
6. Flow-Control Weirs: As Required.
7. Outlet: Bottom.
8. Outlet Type: No hub or Threaded.
9. Extension Collars: As Required.
10. Underdeck Clamp: As Required.
11. Expansion Joint: As Required.
12. Sump Receiver Plate: As Required.
13. Dome Material: Aluminum or Stainless Steel.
14. Perforated Gravel Guard: Stainless steel.
15. Vandal-Proof Dome: Required.
16. Water Dam: 2 inches high on Overflow Drains.

B. Cast-Iron, Medium-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:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.

2. Standard: ASME A112.6.4.

3. Body Material: Cast iron.
4. Dimension of Body: 8- to 12-inch diameter.
5. Combination Flashing Ring and Gravel Stop: As Required.
6. Flow-Control Weirs: As Required.
7. Outlet: Bottom.
8. Outlet Type: No hub or Threaded.
9. Extension Collars: As Required.
10. Underdeck Clamp: As Required.
11. Expansion Joint: As Required.
12. Sump Receiver Plate: As Required.
13. Dome Material: Aluminum or Stainless Steel.
14. Wire Mesh: Stainless steel or brass over dome.
15. Perforated Gravel Guard: Stainless steel.
16. Vandal-Proof Dome: As Required.
17. Water Dam: 2 inches high om Overflow drains.

C. Cast-Iron, Small-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:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 8-inch diameter.
5. Combination Flashing Ring and Gravel Stop: [Not required] [Required].
6. Outlet: Bottom or Side.
7. Outlet Type: No hub or Threaded.
8. Extension Collars: As Required.
9. Underdeck Clamp: As Required.
10. Expansion Joint: As Required.
11. Sump Receiver Plate: As Required.
12. Dome Material: Cast iron.
13. Wire Mesh: Stainless steel or brass over dome.
14. Vandal-Proof Dome: Required.

D. Metal, Cornice and Gutter 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:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 6-inch diameter.
5. Outlet: Bottom, Side or 45-degree angle.
6. Outlet Type: Threaded.
7. Dome Material: Bronze.
8. Wire Mesh: Stainless steel or brass over dome.
9. Vandal-Proof Dome: Required.

E. Metal, Parapet 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:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Outlet: Back or Angle.

5. Outlet Type: Threaded.
6. Grate Material: Bronze or Nickel-bronze alloy.
7. Wire Mesh: Stainless steel or brass over grate.
8. Vandal-Proof Grate: Required.

F. Metal, Large-Sump, Promenade 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:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. MIFAB, Inc.
    d. WATTS.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 12- to 14-inch diameter.
5. Dimension of Frame and Grate: Nominal 12 to 14 inches square.
6. Outlet: Bottom or Side.
7. Outlet Type: No hub or Threaded.
8. Grate Material: Bronze or Nickel-bronze alloy.
9. Vandal-Proof Grate: Required.
10. Extension Collars: As Required.
11. Underdeck Clamp: As Required.
12. Expansion Joint: As Required.
13. Sump Receiver Plate: As Required.

G. Metal, Medium-Sump, Promenade 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:

    a. Jay R. Smith Mfg. Co.
    b. MIFAB, Inc.
    c. Wade; a subsidiary of McWane Inc.
    d. Zurn Industries, LLC.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: 11- to 12-inch diameter.
5. Dimension of Frame and Grate: Nominal 12 inches square.
6. Outlet: Bottom or Side.
7. Outlet Type: No hub or Threaded.
8. Grate Material: Bronze or Nickel-bronze alloy.
9. Vandal-Proof Grate: As Required.
10. Extension Collars: As Required.
11. Underdeck Clamp: As Required.
12. Expansion Joint: As Required.
13. Sump Receiver Plate: As Required.

H. Metal, Small-Sump, Promenade 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:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. Wade; a subsidiary of McWane Inc.
    d. WATTS.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 8-inch diameter.
5. Dimension of Frame and Grate: Nominal 8 inches square.
6. Outlet: Bottom.
7. Outlet Type: No hub or Threaded.
8. Grate Material: Bronze or Nickel-bronze alloy.
9. Vandal-Proof Grate: As Required.
10. Extension Collars: As Required.
11. Underdeck Clamp: As Required.
12. Expansion Joint: As Required.
13. Sump Receiver Plate: As Required.

I. Metal, Medium-Sump, Deck 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:

    a. Jay R. Smith Mfg. Co.
    b. MIFAB, Inc.
    c. Wade; a subsidiary of McWane Inc.
    d. WATTS.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Flange: Anchor with weep holes as required.
5. Clamping Device: As Required.
6. Integral Backwater Valve: As Required.
7. Outlet: Bottom or Side.
8. Outlet Type: No hub or Threaded.
9. Grate Material: Cast or ductile iron.
10. Grate Finish: Stainless Steel.
11. Overall Dimension of Frame and Grate: Nominal 12 to 14 inches round or square.
12. Top-Loading Classification: Heavy Duty.
13. Vandal-Proof Frame and Grate: Required.

J. Metal, Small-Sump, Deck 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:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.

2. Standard: ASME A112.6.4.
3. Body Material: Metal.
4. Flange: Anchor with weep holes as required.
5. Clamping Device: As Required.
6. Integral Backwater Valve: As Required.
7. Outlet: Bottom or Side.
8. Outlet Type: No hub or Threaded.
9. Grate Material: Cast or ductile iron.
10. Grate Finish: Stainless Steel.
11. Overall Dimension of Frame and Grate: Nominal 8 inches round or square.
12. Top-Loading Classification: As Required.
13. Vandal-Proof Frame and Grate: Required.

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

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. J.R. Hoe & Sons Inc.
b. Neenah Foundry Company.

2. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
3. Size: Inlet size to match downspout and NPS 4 outlet.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.03 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:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, 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:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing or Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: As Required.
7. Outlet Connection: No hub, Hub with gasket or Threaded.
8. Closure: Brass plug with straight threads and gasket or Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads or setscrews.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy or Painted cast iron.
11. Frame and Cover Shape: Round. Square where requested by owner.
12. Top Loading Classification: Extra-Heavy or Heavy duty for exterior locations. Light or Medium Duty for location within building.
13. Riser: ASTM A 74, Extra-Heavy or 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:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: No-hub, 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.

6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Test Tees:

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. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 - EXECUTION

3.01 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 downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.

D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

E. 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. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install horizontal backwater valves in floor with cover flush with floor.

I. Install drain-outlet backwater valves in outlet of drains.

J. Install test tees in vertical conductors and near floor.

K. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

L. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

M. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

N. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 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.

3.04 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

SECTION 22 16 19

DISINFECTION OF POTABLE WATER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the furnishing of all labor and materials for disinfection of the potable water system. Potable water systems are those systems which carry domestic water from the supply main without isolation of the branch by a backflow prevention device. Install all plumbing fittings and valves necessary to perform the disinfection.

B. This section also includes the furnishing of all labor and materials to sample water in system following completion of procedure and provide bacteriological analysis of the water.

1.02 QUALIFICATIONS

A. Disinfection: Disinfection shall be done by a commercial disinfection company approved by the College. Submit to the College's Representative the name of the proposed company for approval.

B. Bacteriological Analysis: Water testing shall be done by a laboratory approved by the State Department of Health Services. Submit for approval the name of the proposed laboratory as well as the proposed number and location of samples.

C. Provide a certificate of completion per Part B attached standard chlorination report which denotes the lines disinfected, the concentration applied and the amount and type of disinfection agent used, and that disinfection is in accordance with AWWA C-601 and State Health Department requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use an approved chlorine agent, applied in liquid form into the system being disinfected. Chlorine gas or a hypochlorite solution may be used to make up the disinfecting liquid.

PART 3 - EXECUTION

3.01 PRELIMINARY PREPARATION OF THE SYSTEM

A. Provide within 3 feet of the supply main, an injection port for introducing the chlorine solution and a gate valve upstream from the injection port.

B. There shall be no dead-end sections in the system exceeding 3 feet in length. All branches within the system shall lead to an outlet for bleeding and flushing.

C. After final pressure tests, open each fixture or outlet to maximum flow and run until the discharge water is free from particulates.

3.02 CHLORINATION PROCEDURE

A. Notify the College's Representative at least five working days prior to the start date of chlorination per Part A attached chlorination report.

B. Install all fixtures to be served by the potable water system before start of chlorination.

C. Prior to injection, place signs on each fixture being treated, reading "Heavily Chlorinated Water - Do Not Use."

D. Introduce the chlorine into the supply stream at a rate to provide a uniform concentration of chlorine in the entire system. Maintain at least 50 ppm chlorine level at each fixture after a hold period of 24 hours. Do not exceed 150 ppm at any time.

E. Draw the injected chlorine in the system through each outlet and fixture until the specified concentration level is reached. Then close all valves including the service cock and supply valve. Keep the system closed during the 24 hour hold period.

F. The College will require a test for the residual concentration in the system at the end of 24 hours. Release no water from the system until these required samples are taken. A minimum concentration of 50 ppm of chlorine is required at all chosen sampling points.

G. After approval to proceed, flush the system at a relatively high velocity to remove the injected chlorine to a concentration in the system of no more than 0.5 ppm above that in the normal supply.

H. After approval to proceed, secure the entire system for at least three days prior to taking samples for bacteriological analysis.

3.03 SAMPLING AND NOTIFICATION

A. At the completion of the three day hold period, take bacteriological water samples with observation by the College's Representative.

B. Sample bottles must be provided by the approved laboratory. After the samples have been collected, the College's Representative may allow temporary use of the water system pending results of the bacteriological analysis of the samples. The system cannot be used unless such allowance in writing is given.

C. Upon completion of sampling, submit the certificate of completion to the College's Representative for approval.

3.04 ANALYSIS

A. Perform qualitative and quantitative bacterial analysis on the water samples and submit a laboratory report. The report must include the presence of any E. Coli bacteria in a 100 ml

sample (this must be negative to be acceptable) and a total plate count of bacteria per cc of the sample (this must be less than 100, or equal to the supply).

3.05 FINAL ACCEPTANCE

A. Upon satisfactory completion of all procedures and receipt of acceptable bacteriological results, written approval of the system will be provided by the College's Representative per Part C attached standard chlorination report. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to the College.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

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.

1.02 SUMMARY

A. Section Includes:

1. Water closets.
2. Water closet Flushometer valves and tanks.
3. Toilet seats.
4. Urinals
5. Urinal Flushometer Valves
6. Lavatories.
7. Lavatory Faucets.
8. Service sinks.
9. Laminar-flow, faucet-spout outlets.
10. Lavatory and Sink Supply Fittings.
11. Lavatory and Sink Waste Fittings.
12. Grout.
13. Supports.

B. Related Requirements:
1. Section 224713 "Drinking Fountains" for drinking fountain units.

1.03 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.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fixtures, faucets, flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.05 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

2.01 Plumbing Fixtures

A. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.

B. Effective March 1, 2017, all single user-user toilet facilities shall be identified as Gender Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.2.6.3. No pictogram, text or braile is required on the symbol. If tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section Section 11B-703. Examples of appropriate designations are “ALL-GENDER RESTROOM,” “RESTROOM” or “UNISEX RESTROOM.” DSA BU 17-01.

C. Accessible plumbing fixtures shall comply with all the requirements in CBC Division 6.

D. Clearance around accessible water closets and in toilet comp[artments shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum measured perpendicular from the rear wall per CBC Section 11B-604.3.1.

E. Heights and location of all accessible fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

F. Accessible fixture controls shall comply with CBC Sections 11B-602.3 for drinking fountains, 11B-604.6 for water closets, 11B-604.9.5 for children’s water closets, 11B605.4 for urinals, 11B-606.4 for lavatories and sinks, 11B-607.5 for bathtubs, 11B-608.5 for showers, and 11B-611.3 for washing machines and clothes dryers.

2.02 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:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   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.
6. Support: See below.
7. Water-Closet Mounting Height: Standard or Accessible or per Architectural drawings.

B. Water Closets: Wall mounted, back spud.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard.
   b. Kohler Co.
   c. TOTO USA, INC.
   d. Zurn Industries, LLC.

2. Bowl:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   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; back.

3. Flushometer Valve: See below.
4. Toilet Seat: See below.
5. Support: See below.
6. Water-Closet Mounting Height: Standard or Accessible or per Architectural drawings.

2.03 WATER CLOSET FLUSHOMETER VALVES

A. Electronic Flushometer Valves:

1. Manufacturer: Sloan “Royal” model 111-1.28-SF-ESS-TMO-HW 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. Standard: ASSE 1037.
4. Type: Diaphragm.
5. Minimum Pressure Rating: 125 psig.
6. Features: Include integral check stop, backflow-prevention device and True Mechanical override switch.
7. Material: Brass body with corrosion-resistant components.
8. Exposed Flushometer-Valve Finish: Chrome plated.
9. Panel Finish: Chrome plated or stainless steel.
10. Style: Exposed.
11. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in CEC, 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 CEC, by a qualified testing agency, and marked for intended location and application.
13. Consumption: 1.28 gal. per flush.
14. Minimum Inlet: NPS 1.
15. Minimum Outlet: NPS 1-1/4.

2.04 TOILET SEATS

A. Toilet Seats:

1. Manufacturer: Olsonite model 95SSCT 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.
3. Standard: IAPMO/ANSI Z124.5.
4. Material: Plastic.
5. Type: Commercial, Heavy duty.
6. Shape: Elongated rim, open front.
7. Hinge: Self-sustaining, check-raising.
8. Hinge Material: Noncorroding metal, stainless steel.
9. Seat Cover: Not required.
10. Color: White.

2.05 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, washout, accessible.

1. Manufactures: Kohler “Brandon” model K-4991-ET or approved equal.
2. Fixture:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Washout with extended shields.
   d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
   e. Water Consumption: Low.

f. Spud Size and Location: NPS 3/4, top.
g. Outlet Size and Location: NPS 2, back.
h. Color: White.

3. Flushometer Valve: See below
4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
b. Size: NPS 2.

5. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights..
6. Urinal Mounting Height: Standard or accessible per Architectural drawings.

2.06 URINAL FLUSHOMETER VALVES

A. Electronic flushometer valves:

1. Manufactures: Manufacturer: Sloan "Royal" model 186-0.125-DBP-SF-ESS-TMO-HW or approved equal.
2. Standard: ASSE 1037.
3. Type: Diaphragm
4. Minimum Pressure Rating: 125 psig.
5. Features: Include integral check stop and backflow-prevention device and true mechanical override switch.
6. Material: Brass body with corrosion-resistant components.
7. Exposed Flushometer-Valve Finish: Chrome plated.
8. Panel Finish: Chrome plated or stainless steel.
9. Style: Exposed.
10. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in CEC, by a qualified testing agency; and marked for intended location and application.
11. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951; listed and labeled as defined in CEC, by a qualified testing agency; and marked for intended location and application.
12. Consumption: 0.125 gal. per flush.
13. Minimum Inlet: NPS 3/4.
14. Minimum Outlet: NPS 1-1/4.

2.07 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Rectangular, Round or Oval, self-rimming, vitreous china, counter or undercounter mounted.

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 Standard.

b. Crane Plumbing, L.L.C.
c. Gerber Plumbing Fixtures LLC.
d. Kohler Co.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Self-rimming for above-counter mounting.
c. Nominal Size: Rectangular, 20 by 17 inches.
d. Faucet-Hole Punching: One hole.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Sealant.

3. Faucet: "Solid-Brass, Automatically Operated Lavatory Faucets" Article.

2.08 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Zurn Industries, LLC.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Oval, [**19 by 16 inches**] [**22 by 14 inches**] [**23 by 15 inches**] <**Insert dimensions**>.
d. Faucet-Hole Punching: [**One hole**] [**Three holes, 2-inch centers**] [**Three holes, 4-inch centers**].
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Chair carrier.

3. Faucet: **<Insert lavatory faucet designation from "Solid-Brass, Manually Operated Faucets" or "Solid-Brass, Automatically Operated Lavatory Faucets" Article>**.
4. Support: Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
5. Lavatory Mounting Height: [**Standard**] [**Handicapped/elderly according to ICC A117.1**].

2.09 SOLID-BRASS, 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, electronic-sensor-operated, solid-brass valve.

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. Chicago Faucets; Geberit Company.
    b. Delta Faucet Company.
    c. Moen Incorporated.
    d. T&S Brass and Bronze Works, Inc.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: [Single hole] <Insert type>.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.35 gpm.
9. Mounting Type: Deck, concealed.
10. Spout: Rigid type.
11. Spout Outlet: Aerator type.
12. Drain: Not part of faucet.

2.10 SERVICE SINKS

A. Service Sinks: Enameled, cast iron, trap standard mounted.

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 Standard.
    b. Commercial Enameling Company.
    c. Gerber Plumbing Fixtures LLC.
    d. Kohler Co.

2. Fixture:

    a. Standard: ASME A112.19.1/CSA B45.2.
    b. Type: Service sink with back.
    c. Back: No holes on fixture.
    d. Color: White.
    e. Mounting: NPS 3 P-trap standard with grid strainer inlet, cleanout, and floor flange.
    f. Rim Guard: On front and sides.

3. Faucet: Refer to Fixture Schedule on drawing P002.

4. Support: Type II sink carrier.
5. Lavatory Mounting Height: Refer to Architectural drawings for fixture heights.

B. Service Sinks: Enameled, cast iron, floor mounted.

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 Standard.
   b. Commercial Enameling Company.
   c. Gerber Plumbing Fixtures LLC.
   d. Kohler Co.

2. Fixture:

   a. Standard: ASME A112.19.1/CSA B45.2.
   b. Style: With front apron and raised back.
   c. Nominal Size: 28 by 28 inches.
   d. Color: White.
   e. Drain: Grid with NPS 2 or NPS 3 outlet.
   f. Rim Guard: Coated wire.

3. Faucet: <Insert sink-faucet designation from "Sink Faucets" Article>.

2.11 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF 372 for faucet-spout-outlet materials that will be in contact with potable water.

B. 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. AM Conservation Group, Inc.
2. Chronomite Laboratories, Inc.
3. NEOPERL, Inc.
4. T&S Brass and Bronze Works, Inc.

C. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.12 LAVATORY AND SINK SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. Lavatories: NPS 3/8Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2. Sinks: NPS 1/2Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.13 LAVATORY AND SINK WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 or NPS 1-1/2offset and straight tailpiece.

C. Traps:

1. Lavatories: NPS 1-1/2 by 1-1/4.
2. Sinks: NPS 1-1/2.
3. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inchthick brass tube to wall and chrome-plated, brass or steel wall flange.
4. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch thick stainless-steel tube to wall; and stainless-steel wall flange.

D. Continuous Waste:

1. Size: NPS 1-1/2” or NPS 2”.
2. Material: Chrome-plated, 0.032-inchthick brass tube.

2.14 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.15 SUPPORTS

A. Water Closet 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. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

B. Type I & II Urinal 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. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

C. Type I & II Sink 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. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

D. Type I, II & III Lavatory 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. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. 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 floor-mounted, back-outlet water closets attached to building floor substrate, onto 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 wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
5. Install trap-seal liquid in urinals.

F. Urinal Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.

3. Use carriers without waste fitting for urinals with tubular waste piping.
4. 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."

3.03 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

D. and Vent Piping."

E. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.04 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.

3.05 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 23 00 00

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 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

1.02 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.

1.03 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.

1.04 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.

1.05 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.

1.06 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

1.07 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.

1.08 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.

1.09 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-builts 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

3.01 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.

3.02 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.

3.03 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.

3.04 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

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 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.
6. Supports and anchorages.

1.02 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, 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.

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.

1.03 SUBMITTALS

A. Welding certificates.

B. Product Information for approval before purchase

C. Operation and Maintenance Manuals

1.04 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

2.01 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.

2.02 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.

F. Welding Filler Metals: Comply with AWS D10.12.

2.03 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.

2.04 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

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 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.

1.02 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

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.02 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.

2.03 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.

E. Rotor: Random-wound, squirrel cage.

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.

2.04 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.

2.05 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, maintenance clearances and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align motor with base. Align motors, bases, shafts, pulleys and belts with driven equipment, or couplers. Tension belts according to manufacturer's written instructions.

B. Comply with mounting and anchoring requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC."

C. Connect motor leads to power source using rings and bolts or split bolts as needed. Insulation of connected motor leads shall be of the highest quality and designed to withstand the same temperature as the internal windings. Ordinary electrical tape is not generally suitable for this service and shall not be used as the only means of insulation. Wire nuts are prohibited.

D. Motor power leads shall be marked at the source and at the connection box on the motor.

3.03 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
2. Test interlocks and control features for proper operation.
3. Verify that current in each phase is within nameplate rating.

B. Testing: Owner’s Representative may engage a qualified testing agency to perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspections stated in NETA ATS, Section 7.15.1 and certify compliance with test parameters.

C. After the Owner’s testing agency is finished, correct any malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and the University shall retest.

3.04 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 14

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 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, Electrical Motors, Air Handling Units, Fans, Energy Management System.

1.02 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.

1.03 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)
4. State of California Electrical Code (CEC).
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.

1.04 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.

1.05 MANUFACTURERS:

A. ABB, Danfoss, or Yaskawa.

1.06 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

2.01 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.

C. The drive shall be mounted in NEMA 12 enclosure. Drives not located indoors shall have NEMA 4 enclosure. The entire VFD package shall be in a free standing metal enclosure, and be completely factory assembled. Plastic enclosure is not acceptable.

D. The cabinet shall be front access only. The unit shall be suitable for operation in ambient temperature - 14°F to 104°F (up to 122°F with cover removed).

E. The drive shall be a PWM (Pulse Width Modulated) transistorized inverter using IGBTs (Insulated Gate Bipolar Transistors) and must be fully digital.

F. The drive shall have a common design for all horsepower models required for this project.

2.02 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.
8. Shall have the following user selectable contingencies in the event of loss of analog control signal while the drive is running before loss:

    a. Run at the user set lower frequency limit.
    b. Run at the user set upper frequency limit.
    c. Trip with a signal loss fault.
    d. Run at user selected percentage of the last valid frequency signal.

C. Shall be equipped with both local/remote and manual/auto keys on touchpad.

1. Hand-Off-Auto keypad control and manual speed shall be provided on the keypad. When in “Hand”, the VFD will be started, and the speed will be controlled from the speed up or speed down button. Then in “Off”, the VFD will be stopped. When in “Auto”, the VFD will start via an external contact enclosure, and its speed will be controlled via an external speed reference.
2. Shall have the capability of storable special custom user setting.
3. Shall restart into a rotating motor operating in either the forward or reverse direction and match that frequency.
4. Shall have adjustable soft stall (10% - 150%) which reduces frequency and voltage of the inverter to sustain a run in an overload situation.
5. Shall have adjustable UL listed electronic overload protection (10% - 100%).The drive shall have a custom programmable volt/hertz pattern.
6. Serial RS232C communication standard
7. Provide BACnet interface for EMS control.

D. Protective Features

1. Provide phase reversal protection.
2. Provide input and output line reactors to reduce harmonic noise to 5% THD rms.
3. Shall have main disconnecting integral input circuit breaker with minimum interrupting rating not less than 110% of the available fault level. Circuit breaker shall be by Square D, General Electric, or equal. The circuit breaker operating mechanism shall be lockable and readily accessible on the outside of the enclosure.
4. The drive shall be capable of re-setting faults remotely and locally.

5. The drive shall be programmable to alert the following alarms:

   a. Over torque alarm,

      1) Motor overload pre-alarm
      2) Undercurrent alarm
      3) Over current pre-alarm
      4) Communication error alarm

6. The drive shall identify and display the following faults:

   a. Over current (350% instantaneous or 170% RMS) during normal run, acceleration or deceleration trip.

      1) Over current on the DC Bus during normal run trip, acceleration trip, or deceleration trip.
      2) Over voltage (130% of VFD's rated voltage) during normal (constant speed) run trip, acceleration trip, or deceleration trip.
      3) Under voltage (65% of the VFD's rated voltage) trip.
      4) Over temperature.
      5) Ground Fault either running or at start
      6) Emergency off trip message.
      7) RAM, ROM, CPU error
      8) Communication interruption error
      9) Output current detection circuit error
      10) Over torque trip

   b. Monitor Functions
      1) The drive digital display shall be capable of displaying the following: frequency, % current, current amps, % voltage I/O, voltage in volts I/O, RPM, GPM, I/O Watts, torque, and input reference signal, kWh.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide factory mounting brackets and attachments for VFDs. Field modification or drilling of enclosures is not permitted. Mounting brackets and supports shall not block required access and clearances for VFD.

3.2 START-UP AND COMMISSIONING SERVICE

A. The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for drive field repairs shall not be acceptable as commissioning agents. Coordinate commissioning requirements with the Commissioning Authority as specified under Section 230800 "Commissioning of HVAC."

B. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Included in this service shall be (as a minimum):
   1. Verification of contractor wire terminations to the VFD and its optional circuitry.
   2. Installation verification for proper operation and reliability of the VFD, the motor being drive, and the building automation system.
   3. Conform to training requirements specified elsewhere. In addition, the VFD manufacturer's certified trainer shall provide up to one-hour of customer operator training on operation and service diagnostics at the time of the equipment commissioning.
   4. Measurements for verification of proper operation on each of the following items:
      a. Motor voltage and frequency. Verification of proper motor operation.
      b. Control input for proper building automation system interface and control calibration.
      c. Calibration check for the following setpoints (and adjustments as necessary):
         1) minimum speed
         2) maximum speed
         3) acceleration rate
         4) deceleration rate
      d. VFD manufacturer technician shall document all default and custom drive settings.
   5. Submit Start-Up and Commissioning Reports.

3.3 EXAMINATION

A. Contractor shall coordinate with Manufacturer/Supplier to verify that jobsite meets factory recommended and code required conditions for proper VFD installation prior to the installation. Additionally, contractor shall address Manufacturer/Supplier's recommendations to assure proper installation prior to the installation. Manufacturer/Supplier shall visit jobsite subsequent to the installation to verity VFD's are installed properly. Items considered shall include (at a minimum):
   1. Clearance spacing
   2. Temperature, contamination, dust, and moisture of the environment.
   3. Separate conduit installation of the motor wiring, power wiring, and control wiring.
   4. Installation per the manufacturer's recommendation.
   5. Measure voltage rise, time, and magnitude.
   6. Cover and protect the VFD from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.
   7. VFD input and output power shall be installed in separate conduits.

END OF SECTION 230549

END OF SECTION

SECTION 23 05 19

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

1.02 ACTION SUBMITTALS

B. 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.

C. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

D. Product Certificates: For each type of meter and gage, from manufacturer.

1.04 CLOSEOUT SUBMITTALS

E. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 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.

2.02 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
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: NPT 1/2, NPT 3/4, or NPT 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.

2.03 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.

2. Standard: ASME B40.100.
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.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.04 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).

2.05 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 Gerneral 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.

2.06 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

3.01 INSTALLATION

A. Install thermometers in the following locations:

1. Inlet and outlet of fluid cooler.
2. Inlet and outlet of boilers.
3. Inlet and outlet of heat pump water coil.
4. Entrance and exit of main building service.

B. Install pressure gages in the following locations:

1. Inlet and outlet of fluid cooler.
2. Inlet and outlet of boilers.
3. Inlet and outlet of heat pump water coil.
4. 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

1.01 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. High-performance butterfly valves.
4. Bronze gate valves.
5. Iron gate valves.
6. Bronze globe valves
7. Chainwheels.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.02 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.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.04 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.

1.05 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

2.01 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.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 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:
   a. Standard: MSS SP-110.
   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.

2.03 IRON, SINGLE-FLANGE BUTTERFLY VALVES (SIZES 2-1/2" THROUGH 12")

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Jenkins Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. DeZurik Water Controls.
   d. Milwaukee Valve Company.
   e. 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.

f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze or ductile iron.

2.04 HIGH-PERFORMANCE BUTTERFLY VALVES (SIZES 2-1/2" THROUGH 12")

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Flowseal.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. DeZurik Water Controls.
   d. Milwaukee Valve Company.
   e. NIBCO INC.

2. Description:
   a. Standard: MSS SP-68.
   b. CWP Rating: 285 psig at 100 deg F.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: Carbon steel or ductile iron.
   e. Seat: Reinforced PTFE or metal.
   f. Stem: Stainless steel; offset from seat plane.
   g. Disc: Carbon steel.
   h. Service: Bidirectional.

2.05 BRONZE GATE VALVES (SIZE 2" AND SMALLER)

A. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.
   b. Milwaukee Valve Company.
   c. NIBCO INC.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron.

2.06 IRON GATE VALVES (SIZES 2-1/2" THROUGH 12")

A. Class 125, OS&Y, Iron Gate Valves. (Size 3" and Larger):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Milwaukee Valve Company.
   e. NIBCO INC.

2. Description:
   a. Standard: MSS SP-70, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Disc: Solid wedge.
   h. Packing and Gasket: Asbestos free.

2.07 BRONZE GLOBE VALVES (SIZES 2" AND SMALLER)

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.
   b. Milwaukee Valve Company.
   c. NIBCO INC.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded or solder joint.
   e. Stem and Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron.

2.08 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.
   b. Milwaukee Valve Company.
   c. NIBCO INC.

2. Description:
   a. Standard: MSS SP-125.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM A 162, gray iron.

d. Style: Compact wafer
e. Seat: Bronze.
f. Spring: Stainless Steel.

2.09 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Roto Hammer Industries.
2. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball and butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
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.

3.02 CONDENSER-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, stainless-steel trim.
3. Bronze Gate Valves: Class 125, RS, bronze.
4. Bronze Globe Valves: Class 125, bronze disc.

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, Center-Guided Check Valves: Class 125, compact-wafer and globe, metal resilient seat.

3.03 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

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.02 REFERENCES

A. ASME B31.9 Building Services Piping

B. MSS SP58 Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application and installation

C. MSS SP-69 Pipe Hangers and Supports – Selection and Application

D. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices

1.03 DEFINITIONS

A. ASCE: American Society of Civil Engineers

B. ASME: American Society of Mechanical Engineers

C. ASTM: America Society for Testing and Material

D. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

E. MFMA: Metal Framing Manufacturers Association

F. SEI: Structural Engineering Institute

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to Standard ASCE/SEI 7 – Minimum Design Loads for Buildings and Other Structures.

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.

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”.

B. Product Data: For each type of product indicated including component cut sheets and pre-approved details.

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

D. 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. Design Calculations: Calculate requirements for designing trapeze hangers.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

A. Structural Steel 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 current ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 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 HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE 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.

2.02 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 or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

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.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe 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 stainless steel.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, 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.

2.04 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with in-turned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Metallic Coating: Electroplated zinc, Mill galvanized, In-line, hot galvanized or Mechanically-deposited zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with in-turned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of PVC coated carbon steel, hot dipped galvanized carbon steel or stainless steel.

2.05 VERTICAL RISER CLAMPS FOR INSULATED PIPES

A. Vertical Riser Clamps for Insulated Steel Pipes:

1. Manufacturer shall be Pipe Shields Inc. Model E2100 or equal.
2. Carbon steel pipe material, steel straps and base that is compliance with ASTM A36.
3. Insulation shall be calcium silicate, asbestos free, treated with water repellant.
4. Jacket shall be galvanized steel that is in compliance with ASTM A-527.
5. Fasteners shall comply with ASTM A-307 plated.
6. Coating shall be primer coated.

B. Vertical Riser Clamps for Insulated Copper Pipes:

1. Manufacturer shall be Hydra-Zorb Titan Riser Clamp or equal.
2. 25/50 flame spread/smoke spread index.
3. Eliminates insulation compression.
4. Crush resistant.
5. Vertical load rating up to 2400 lbs.

2.06 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers

1. Pipe Shields Inc.
2. Pittsburg Corning Foamglas ONE
3. ITW Insulation Systems TRYMER 2000 XP

B. Cold Piping: Insulation-Insert Material - 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. Hot Piping: Insulation-Insert Material - 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.

2.07 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.08 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: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

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.

2.09 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. 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.

G. 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.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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 same thickness as piping insulation.

3.02 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.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for 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.

3.04 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.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as 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 areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 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 finish.

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 corrosion-resistant attachments for hostile environment applications.

G. Copper Pipe or Tubing

1. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
2. Or use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. 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.
4. 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.
5. 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.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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.
15. 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.
16. 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.
17. 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 might occur.
18. 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 might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. 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 might occur and vertical adjustment is not necessary.
21. 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 might be required in addition to expansion and contraction.

J. 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 non-insulated pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of non-insulated pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
3. Insulated piping shall use vertical riser clamps for insulated pipe.

K. 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, 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.

L. 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.

M. 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.

N. 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.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS 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.

1.02 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.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Spring hangers.
11. Snubbers.
12. Restraint channel bracings.
13. Restraint cables.
14. Seismic-restraint accessories.
15. Mechanical anchor bolts.
16. Adhesive anchor bolts.
17. Vibration isolation equipment bases.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.03 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. 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 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 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.

C. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

D. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases 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, operation, and seismic forces required to select vibration isolators and seismic restraints and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

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. Retain first subparagraph below if Project includes equipment mounted outdoors. 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 agency acceptable to authorities having jurisdiction], showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

E. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For [**air-spring mounts**] [**and**] [**restrained-air-spring mounts**] to include in operation and maintenance manuals.

1.07 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 OPM number from OSHPD, 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

2.01 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Contractor shall consult on requirements with Structural Engineer of Record or other acceptable qualified engineer by the authority having jurisdiction.

2.02 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type MBSW

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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: Waffle pattern.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric

2.03 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type ND

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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.

2.04 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type BR

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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.

2.05 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type SLFH

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.06 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type C

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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 attachment and leveling bolt, threaded mounting holes and internal leveling device.

2.07 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type SLR

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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 and 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.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.08 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type SSLFH

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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.

2.09 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. Manufacturer and Model:

    a. Basis of Design

        1) Mason Industries Type SSLFH

    b. Or Approved Equal by:

        1) California Dynamics Corporation
        2) Kinetics Noise Control
        3) Vibrex
        4) Isotech Industries

2. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
3. 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. Manufacturer and Model:

    a. Basis of Design

        1) Mason Industries Type ADA

    b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

2. 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 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.

1. Manufacturer and Model:

a. Basis of Design

1) Mason Industries Type 30N OR PC30NS

b. Or Approved Equal by:

1) California Dynamics Corporation
2) Kinetics Noise Control
3) Vibrex
4) Isotech Industries

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.

2.12 SNUBBERS

A. Manufacturer and Model:

1. Basis of Design
   a. Mason Industries Type Z-1011

2. Or Approved Equal by:
   a. California Dynamics Corporation

b. Kinetics Noise Control
c. Vibrex
d. Isotech Industries

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.

2.13 RESTRAINT CHANNEL BRACINGS

A. Manufacturer and Model:

1. Basis of Design
   a. Mason Industries Type Seismic Sway Bracing System

2. Or Approved Equal by:
   a. California Dynamics Corporation
   b. Kinetics Noise Control
   c. Vibrex
   d. Isotech Industries

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.

2.14 RESTRAINT CABLES

A. Manufacturer and Model:

1. Basis of Design

   a. Mason Industries Type SCBA Assembly, SCR, UC & CCB

2. Or Approved Equal by:

   a. California Dynamics Corporation
   b. Kinetics Noise Control
   c. Vibrex
   d. Isotech Industries

B. Restraint Cables: ASTM A 603 galvanized 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.

2.15 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturer and Model:

1. Basis of Design

   a. Mason Industries Type SCR, UC & CCB

2. Or Approved Equal by:

   a. California Dynamics Corporation
   b. Kinetics Noise Control
   c. Vibrex
   d. Isotech Industries

B. Hanger-Rod Stiffener: 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.

2.16 MECHANICAL ANCHOR BOLTS

A. Manufacturer and Model:

1. Basis of Design

   a. Mason Industries Type SAB/SAS

2. Or Approved Equal by:

   a. California Dynamics Corporation
   b. Kinetics Noise Control
   c. Hilti

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.

2.17 ADHESIVE ANCHOR BOLTS

A. Manufacturer and Model:

1. Basis of Design

    a. Mason Industries Type SAA

2. Or Approved Equal by:

    a. California Dynamics Corporation
    b. Kinetics Noise Control
    c. Hilti

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.

2.18 VIBRATION ISOLATION EQUIPMENT BASES

PART 3 - EXECUTION

3.01 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.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by 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.

3.03 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.

B. 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 HVAC 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 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 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.

3.04 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 232113 "Hydronic Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall 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.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Structural Engineer of Record.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.06 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

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

a. Equipment labels.
b. Warning signs and labels.
c. Pipe labels.
d. Valve tags.
e. Warning tags.

1.02 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:

a. “No Exception Taken”.
b. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme. See paragraph 2.7.B.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.03 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

2.01 GENERAL

A. Manufacturers:

a. Craftmark Identification Systems
b. Seton Identification Products
c. MSI Marking Services
d. Setmark

2.02 EQUIPMENT LABELS

A. Metal Labels for Equipment:

a. Material and Thickness: Brass or anodized aluminum, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
b. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
c. 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.
d. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.
e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

a. Material and Thickness: Three-layer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick and having predrilled holes for attachment hardware.
b. Color Coding:

a. Letter Color: White.
b. Background Color: Red.

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 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.

2.03 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:

a. Background Color: Yellow.
b. 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.

2.04 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.

a. 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.

b. Lettering Size: At least 1-1/2 inches high.

2.05 VALVE TAGS

A. Valve Tags: Stamped or engraved with ¼-inch letters for piping system abbreviation and ½ inch sequenced numbers.

a. Tag Material: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
b. 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.

a. Valve tag schedule shall be included in operation and maintenance data.

2.06 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

a. Size: Approximately 4 by 7 inches.
b. Fasteners: Brass grommet and wire.
c. Nomenclature: Large-size primary caption such as “DANGER”, “CAUTION” or “DO NOT OPERATE.”
d. Color:

1. Background Color: Yellow.
2. Letter Color: Black.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Provide equipment label on in the space on the t-bar ceiling to note WSHP locations above the ceiling.

3.04 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting"

B. 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:

a. Within one foot of each valve and control device.
b. Near each branch connection and riser takeoff.
c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
d. Near major equipment items and other points of origination and termination.
e. At access doors, manholes, and similar access points that permit view of concealed piping.
f. Spaced at maximum intervals of 20 feet along each run, but not less than once in each room at entrance and exit of each concealed space.
g. On piping above removable acoustical ceilings.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

a. Condenser-Water Piping:

1. Background Color: Green.
2. Letter Color: White.

b. Refrigerant Piping:

1. Background Color: Yellow.
2. Letter Color: Black.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except valves within factory-fabricated equipment units; faucets; convenience and lawn-watering hose connections. 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:

a. Valve-Tag Size and Shape:

1. Condenser Water: 2 inches, round.
2. Hot Water: 2 inches, round.
3. Refrigerant: 2 inches, round.

b. Valve-Tag Color:

1. Condenser Water: Natural.
2. Hot Water: Natural.
3. Refrigerant: Natural.

c. Letter Color:

1. Condenser Water: Black.
2. Hot Water: Black.
3. Refrigerant: Black.

C. All above and below grade and interior and exterior valves shall be tagged. Submit valve tag chart to the Owner Representative for review and approval at the completion of the project.

3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93

STING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 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. Heat exchangers.
   b. Motors.
   c. Condensing units.
   d. Boilers.
   e. Heat-transfer coils.
   f. Pumps

4. Testing, adjusting, and balancing existing systems and equipment.
5. Sound tests.
6. Vibration tests.
7. Duct leakage tests.
8. Control system verification.

1.02 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.03 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site with 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:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.04 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.

B. Contract Documents Examination Report: Submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" 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.

1.05 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

3.01 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.

3.02 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
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.

3.03 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,"

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.

3.04 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."

3.05 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.

3.06 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. 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.

3.07 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.

3.08 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. 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.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. 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.

C. 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.

D. 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.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or by using P/T ports.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. 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.

G. Verify that memory stops have been set.

3.09 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.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

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.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

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.

3.10 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.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

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.

3.11 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.

3.12 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.

3.13 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.
2. Motor horsepower rating.
3. Motor rpm.
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.

3.14 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.15 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.

3.16 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.

3.17 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at <Insert number> locations as designated by the Architect.

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.

3.18 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.

3.19 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.

3.20 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 set points 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.

3.21 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.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

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.

3.22 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.

3.23 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.

3.24 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.
8. Report date.
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.
6. Balancing stations.
7. Position of balancing devices.

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.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

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.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

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.

3.25 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.

3.26 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

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.01 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 233113 "Metal Ducts" for duct liners.

1.02 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.

1.03 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.

1.04 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.

1.05 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.

1.06 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.

1.07 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

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

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.

2.02 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 Polymerics (DP-2502)
3. Line all ductwork as indicated on Drawings.

2.03 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:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

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".

2.04 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:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
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.
5. Color: White.

C. Vapor-Barrier Permeance: ASTM 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:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

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.
5. Color: White.

2.05 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    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.

2.06 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.

2.07 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:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    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.

4. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper 3-mil- thick.
5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil- thick polysurlyn.

2.08 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.
   e.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
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.
4. Adhesion: 90 ounces force/inch in width.
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.

2.09 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:

a. AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
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 3 -EXECUTION

3.01 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.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 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 duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. 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.

3.04 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 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.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over compress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.06 FIELD-APPLIED JACKET INSTALLATION

A. 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.

B. 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.

3.07 FINISHES

A. Insulation with ASJ, 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.
   a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.08 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air in unconditioned space.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with Title 24 energy code.
2. Metal ducts located in conditioned spaces.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.

5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.09 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Supply and return air duct and plenum insulation shall be the following:

1. Mineral-Fiber Blanket: 1.5 inches thick and 0.75-lb/cu. ft. nominal density.

B. Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket thickness as required to achieve 2-hour fire rating.

3.10 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Supply and return air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

3.11 OUTDOOR, 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. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: 0.024 inch thick.
2. Painted Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: 0.024 inch thick.

C. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. [**Painted**]Aluminum, [**Smooth**] [**Stucco Embossed**] with 2-1/2-Inch- Deep Corrugations 0.040 inch thick.

END OF SECTION

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HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Condenser-water piping.
2. Hot-water heating piping
3. Air-vent piping.
4. Safety-valve-inlet and -outlet piping.

1.02 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.03 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Condenser-Water Piping 125 psig at 200 deg F.
2. Hot-Water Heating Piping 125 psig at 200 deg F.
3. Air-Vent Piping: 200 deg F.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.04 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.
3. Chemical treatment.
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.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Field quality-control test reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.07 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

2.01 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.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53, black steel with plain ends; ERW, grade B, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

D. Forged-Steel Flanges and Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding, fittings.
3. Flanges: Raised face, slip-on or flat.

2.03 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:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International Ltd.
e. Matco-Norca, Inc.
f. McDonald, A. Y. Mfg. Co.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Description:

a. Standard: ASSE 1079.
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
b. Electroplated steel nipple. Complying with ASTM F 1545.
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded
e. Lining; Inert and non-corrosive, propylene.

2.04 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 & Gossett 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.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS ½
5. Discharge Connection: NPS ¼
6. CWP Rating: 150 psig
7. Maximum Operating Temperature: 240 deg F

2.05 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.
4. CWP Rating: 125 psig.

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:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

D. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.01 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. Condenser-water piping, aboveground, NPS 2-12” and smaller, shall be the following:

1. Type L draw-temper copper tubing, wrought-copper fittings, and soldered brazed joints.

C. 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.

D. Condenser-water piping, aboveground, NPS 3” and larger shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-case or forged-steel flanges and flange fittings, and welded and flanged joints.

E. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. 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.

3.02 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.

END OF SECTION

SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Hydronic specialty valves.
2. Air-control devices.
3. Strainers.
4. Connectors.

1.02 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”.

B. Product Data: For each type of product:

1. Include construction details and material descriptions for hydronic piping specialties.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.04 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.05 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. 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

2.01 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers:

   a. Bell & Gossett, A Zylem brand.
   b. Arstrong Pumps, Inc.
   c. TACO Comfort Solutions, Inc.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers:

   a. Bell & Gossett, A Zylem brand.
   b. Arstrong Pumps, Inc.
   c. TACO Comfort Solutions, Inc.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

C. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers:

   a. Conbraco Industries, Inc.
   b. Watts Industries, Inc.; Watts Regulators.
   c. Zurn-Wilkins.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.

5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: stainless steel removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

D. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers:

a. Conbraco Industries, Inc.
b. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
c. Kunkle Valve Division.
d. Spence Engineering Company, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.02 COIL PIPING PACKAGE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. NuTech Hydronic Specialty Products..
2. Flow Design Inc.
3. Griswold Controls.

B. Coil Piping Package – 1/2" to 2”:

1. Supply Side:

a. Manual air vent with pressure/temperature port.

1) Brass body, EPDM core and O-ring, knurled handle and cap.
2) Side vent with 1/8" hose barb and 1/4" NPT.
3) Extended length.
4) Minimum rating of 250 PSIG at 250°F.

b. Combination Y-strainer with integral pressure/temperature port. Isolation ball valve with extended handle shall be independent from piping package.

1) Forged or cast brass body. EPDM O-ring. Plated steel handle with vinyl grip. Blow out-proof stem. Chrome plated ball with Teflon seats.
2) Strainer with 20 mesh stainless steel screen with removable cap. Strainer shall be fitted with a hose end blow down valve with cap and chain.
3) Minimum rating of 600 PSIG at 250°F.

2. Return Side:

a. Union with pressure/temperature port and manual air vent.

1) Brass O-ring type union. EPDM O-ring. Knurled handle and cap. Blowout-proof stem. Side vent with 1/8" hose barb. 1/4" and 1/2" NPT. Extended length.
2) Minimum Ratings 600 PSIG at 250°F.

b. Integral union with pressure/temperature port. Isolation ball valve with extended handle shall be independent from piping package.

1) Forged or cast brass body. EPDM O-ring. Plated steel handle with vinyl grip. Blow out-proof stem. Chrome plated ball with Teflon seats.
2) Minimum rating of 600 PSIG at 250°F.

c. No manual or automatic balancing valves required on main pipe.

C. Coil Piping Package 2-1/2" to 12":

1. Supply Side:

a. Manual air vent with pressure/temperature port.

1) Brass body, EPDM core and O-ring, knurled handle and cap.
2) Side vent with 1/8" hose barb and 1/4" NPT.
3) Extended length.
4) Minimum rating of 250 PSIG at 250°F.

b. Combination flange end Y-strainer with integral pressure/temperature port. Isolation high performance butterfly valve with extended handle shall be independent from piping package.

1) Y-strainer shall have cast iron body. Fiber gasket. Stainless steel strainer screen. ANSI 125# Flanged. Strainer shall include pressure/temperature port and drain valve.
2) High performance butterfly valve shall be lug type with ductile iron body, designed to be installed at inlet of strainer. Resilient seat for bubble tight shut off. Blowout proof stem with pinned disc. Universal mounting flange conforms to ISO-5211. 2.5"-6" supplied with adjustable flow positioning plate. Sizes 8"-12" provided with a gear operator.
3) Minimum rating of 175 PSIG at 250°F.

2. Return Side:

a. Union with pressure/temperature port and manual air vent.

1) Brass O-ring type union. EPDM O-ring. Knurled handle and cap. Blowout-proof stem. Side vent with 1/8" hose barb. 1/4" and 1/2" NPT. Extended length.
2) Minimum Ratings 600 PSIG at 250°F.

b. Integral union with pressure/temperature port. Isolation high performance butterfly valve with extended handle shall be independent from piping package.

1) High performance butterfly valve shall be lug type with ductile iron body, designed to be installed between all types of ANSI 125/150 flanges. Resilient seat for bubble tight shut off. Blowout proof stem with pinned disc. Universal mounting flange conforms to ISO-5211. 2.5"-6" supplied with adjustable flow positioning plate. Sizes 8"- 12" provided with a gear operator.
2) Minimum rating of 175 PSIG at 250°F.

D. Flange end pressure/temperature port and manual air vent:

1. Pressure/temperature and manual air vent port.
2. Minimum rating of 175 PSIG at 250°F.

E. Automatic Balancing Valves:

1. Provide automatic balancing valves at pot feeder to maintain minimum flow.
2. Flowrate shall be factory set and shall valve shall automatically limit the rate of flow to within ±5% of the specified GPM over at least 95% of the control range.
3. For 3/4" valve, the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for cartridge change-out, inspection and cleaning without breaking the main piping.
4. Valve pressure loss shall not exceed seven feet.
5. Valve shall have 2 pressure and temperature ports.
6. The valve handle shall be fitted with a fine tuning memory stop handle to allow for adjusting the control range.
7. The differential pressure across the automatic balancing valve shall be measured for flow verification and to determine the amount of system over heading or under pumping.
8. Provide pressure and temperature test kit with the ability to read differential pressure from 0 to 75 PSIG, and temperature from -10 to 230°F.

2.03 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze body ball valve with stainless steel ball, NPS 1/2.
2. CWP Rating: 150 psig.
3. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Manufacturers:

a. Bell & Gossett No. 87.
b. Spirotherm Spirotap Model VTP.

2. Body: Brass or bronze.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4 or 1/2.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

C. Bladder-Type ASME Expansion Tanks:

1. Manufacturers:

   a. Bell & Gossett Series B.
   b. Wessels Tank Company Type NLA.
   c. Amtrol L Series.

2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Provide with seismic restraint.
4. Bladder: Heavy duty Butyl securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
5. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Coalescing-Type Air and Dirt Separators:

1. Manufacturers:

   a. Bell & Gossett Model CRS.
   b. Armstrong Model DAS.
   c. Amtrol.

2. Tank: Fabricated steel tank; ASME constructed and stamped for 125-psig working pressure and 450 deg F maximum operating temperature.
3. Coalescing Medium: Stainless steel.
4. Air Vent: Threaded to the top of the separator.
5. Inline Inlet and Outlet Connections: Threaded for NPS 2 and smaller; Class 150 flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded to the bottom of the separator.
7. Size: Match system flow capacity.

2.04 STRAINERS

A. Y-Pattern Strainers up to NPS 1.5:

1. Manufacturers:

   a. The Metraflex Company.
   b. Keckley.
   c. Mueller Steam Specialty.

2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded.
4. Strainer Screen: 40 mesh stainless-steel screen.
5. CWP Rating: 125 psig.

B. Y-Pattern Strainers NPS 2 and Larger:

1. Manufacturers:

   a. The Metraflex Company Model LPD.
   b. Or Engineer approved equal.

2. Y-strainer shall be of low pressure drop design with the following Cv values:

   a. 2” Pipe 120
   b. 2.5” Pipe 160
   c. 3” Pipe 236
   d. 4” Pipe 460
   e. 6” Pipe 952
   f. 8” Pipe 1,580
   g. 10” Pipe 2,424
   h. 12” Pipe 3,200

3. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection. Strainer shall be suitable for horizontal and vertical mounting.
4. End Connections: Flanged ends.
5. Strainer Screen: Stainless-steel, screen perforations shall be:

   a. For liquid service for NPS 2 – 3, perforation shall be 0.045”
   b. For liquid service for NPS 4 – 12, perforation shall be 0.125”

6. Pressure Taps: Provide with inlet and outlet pressure plugs.
7. CWP Rating: 125 psig.

C. Basket Strainers:

1. Manufacturers:

   a. The Metraflex Company.
   b. Keckley.
   c. Mueller Steam Specialty.

2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
4. Strainer Basket: Stainless steel material with perforated sides and solid bottom. Basket to be provided with an integral handle for removal and size of perforations to be appropriate for the media. For water service, 2" thru 3" sizes to have .045 perforations, 4" thru 16" to have .125 perforations.
5. CWP Rating: 125 psig.

2.05 CONNECTORS

A. Spherical, Rubber, Flexible Connectors:

1. Manufacturers:

   a. The Metraflex Company.
   b. Keckley.
   c. Mueller Steam Specialty.

2. Body: Fiber-reinforced rubber body.
3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. Performance: Capable of misalignment.
5. CWP Rating: 150 psig.
6. Maximum Operating Temperature: 250 deg F.

B. Pump Suction Diffusers:

1. Manufacturers:

   a. The Metraflex Company Suction Diffuser Flex.
   b. Or Engineer approved equal.

2. Stainless hose, flexible braid, integral rotational vanes, 90° reducing elbow and flanged connection.

   a. Flexible hose section to be 304 stainless steel, close pitch, annular corrugated hose with a type 304 braided outer covering.
   b. End connections to be ANSI class 150 carbon steel plate flanges.
   c. Overall length to allow for a minimum of 6" intermittent flexing.

3. Connectors shall be located upstream of the inlet elbow, and incorporate specially designed stationary vanes that impart a rotational motion as the fluid enters the elbow. Vanes to be capable of counteracting elbow induced turbulence, enabling the fluid to negotiate the turn uniformly, and exit with a flat velocity profile.

C. Pump Discharge Connections:

1. Manufacturers:

   a. The Metraflex Company Vane Flex.
   b. Or Engineer approved equal.

2. Stainless hose, flexible braid, integral straightening vanes and flanged connection.

   a. Flexible hose section to be 304 stainless steel, close pitch, annular corrugated hose with a type 304 braided outer covering.
   b. End connections to be ANSI class 150 carbon steel plate flanges.
   c. Overall length to allow for a minimum of 6" intermittent flexing.

3. Connectors shall incorporate internal flow straightening vanes to reduce turbulence prior to the balancing valve. Vanes to be capable of reducing discharge turbulence equal to 5-10 pipe diameters of straight pipe, while allowing full rated movement of the connector.

PART 3 - EXECUTION

3.01 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 independent control valves in the return water line of each cooling element.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install pump suction diffusers at all suction pump connections and pump discharge flexible connections with straightening vanes to relieve pump and piping stresses and straighten flow.

D. Install piping from boiler air separator to expansion tank with a 2 percent upward slope toward tank.

E. Install one coalescing-type air and dirt separator per system. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

3.03 TERMINAL EQUIPMENT CONNECTIONS

A. Provide flexible pipe connection to and from terminal, VAV or lab boxes.

B. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

C. Install control valves in accessible locations close to connected equipment.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

END OF SECTION

SECTION 23 21 23

HYDRONIC PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Separately coupled, vertically mounted, in-line centrifugal pumps.
4. Separately coupled, base-mounted, end-suction centrifugal pumps.
5. Separately coupled, base-mounted, double-suction centrifugal pumps.

1.02 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.03 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.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and

maintenance manuals.

1.05 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

2.01 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 CEC, 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.

2.02 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 CEC, 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.

2.03 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.
4. Shaft: Stainless steel with lower carbon throttle bushing.
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 seat 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 CEC, 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.

2.04 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.
6. 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.

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 CEC, 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.

2.05 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.
   3. Pump Shaft: Stainless steel.
   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 CEC, 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.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 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.

3.05 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.
6. Start motor.
7. Open discharge valve slowly.

3.06 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION

SECTION 23 25 13

WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following water treatment for closed-loop hydronic systems:

1. Automatic chemical-feed equipment.
2. Chemicals.

1.02 DEFINITIONS

A. Low Voltage: As defined in CEC for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

B. RO: Reverse osmosis.

C. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

D. MSDS: Material Safety Data Sheets.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Inhibitor injection timers.
4. pH controllers.
5. TSS controllers.
6. Chemical solution tanks.
7. Injection pumps.
8. Chemical test equipment.
9. Chemical MSDS.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to hydronic systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For components, from manufacturer. (Not needed if provided by SEOR)

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. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

C. Field quality-control reports.

D. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application and equipment required to achieve water quality defined in "Performance Requirements" Article.
2. Water Analysis: Illustrate water quality available at Project site.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. HVAC Water-Treatment Service Provider shall provide 10 years of documented experience if requested.

1.07 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.

5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Chem Pro.

B. Or College Approved Equal

2.02 PERFORMANCE REQUIREMENTS

A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.

B. The water treatment program shall include:

1. Pre-treatment clean and flush
2. Passivation
3. Inhibitor
4. For remodel project where only a portion of the building is being renovate, the new supply and return piping shall be isolated from the rest of the facility, pre-treated and flushed and passivated. Once passivation is complete the new piping shall be opened to the existing facility loop to be treated with inhibitor.

    a. Provide temporary chemical feed equipment, piping, valves tanks etc. as required to introduce cleaning, degreasing and chemicals for passivation of the piping system.
    b. Provide temporary pump to circulate the water at a minimum of 5 feet per second.
    c. Coordinate supply and return point of connections indicated on the plans with the mechanical contractor.

C. Design HVAC water treatment program on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

D. Closed hydronic systems, including hot-water heating, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TSS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.

9. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.03 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

    1. Capacity: 5 gal..
    2. Minimum Working Pressure: 125 psig.

2.04 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

B. All chemicals and cleaners used shall NOT contain any ammonia based chemicals, nor any phosphates or phosphorous-based chemicals.

    1. Pre-treatment Clean and Flush

        a. Neutral pH product to maintain a pH of 7.0-8.0 in the new piping and coil system. It should not contain any ammonia or phosphate products.
        b. Or approved equal

    2. Passivator

        a. Condenser Water/Chilled Water

            1) pH 8.5 to 10.5
            2) Nitrite at 1,000-1200 ppm
            3) Molybdate at 400 ppm +/- 100-120 ppm
            4) Azole at 40 ppm +/- 10-20 ppm
            5) Or approved equal

        b. Hot Water
            1) pH 8.5 to 10.5
            2) Sodium Nitrite 1,000-1200ppm
            3) Azole at 40 ppm +/- 10-20 ppm
            4) Or approved equal

    3. Inhibitor

a. Nitrite based closed circuit corrosion and scale inhibitor

C. If tied into a TES system, use molybdenum based closed circuit corrosion and scale inhibitor

PART 3 - EXECUTION

3.01 GENERAL

A. Prior to any chemical water treatment or passivation measures, contact College to confirm facility requirements for passivation. Any specific Owner requirements and instructions for passivation measures shall supersede this specification section.

B. If the system is hydrotested before being cleaned and passivated, the hydrotest water shall be city water or its equivalent, and the system and/or coils shall not remain filled and stagnant for more than seven (3) days prior to cleaning and passivation.

3.02 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

B. Water samples taken during each step shall be analyzed, at least, for the pH, conductivity, copper, iron, total alkalinity, phosphate, total hardness, and chlorides. Additional tests shall be taken as noted in this procedure.

3.03 PREPARATION

A. Hydronic piping test for leaks and defects shall be completed prior to the HVAC water treatment is to begin. If testing is performed in segments, submit separate pressure test report for each segment, complete with diagram of portion of piping tested.

B. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.

3.04 INSTALLATION

A. Install in accordance with the HVAC Water Treatment Providers recommendations.

1. Temporary Circulation Pumps

a. Coordinate with the Mechanical Contractor the configuration of any temporary pumps, chemical feed equipment, valves and piping for the chemical cleaning and passivation.
b. Provide pumps, piping connections and shut-off valves between HVAC water-treatment equipment and the piping to allow for the circulation of the water treatment at minimum of 5 FPS velocities.
c. Provide backflow preventers as required for temporary makeup-water fill connections to potable-water systems.

d. The temporary system shall be operational, filled, started and vented prior to cleaning.
e. Mechanical Contractor shall coordinate with the University's representative and the University's existing HVAC Water-Treatment Service Provider to schedule the water treatment and final fill requirements.

B. Install chemical treatment equipment on 4" thick minimum concrete housekeeping pads, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate. (ref 033000 Cast In Place Concrete)

C. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Provide general-duty ball valves as specified in Section 230523.(or 230523.12 Ball Valves) Provide threaded connection on the inlet and outlet with plugs

D. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

E. Install water testing equipment on wall near water chemical application equipment.

F. Install interconnecting control wiring for chemical treatment controls and sensors.

G. Mount sensors and injectors in piping circuits. Coordinate with mechanical contractor.

H. Coordinate with electrical contractor for power to chemical treatment pumps and equipment.

I. Bypass Feeders: Install in closed hydronic systems, including hot-water heating, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
2. Install water meter in makeup-water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
5. Install a swing check on the inlet after the isolation valve.

3.05 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance.

B. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Section 232116 "Hydronic Piping Specialties."

C. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523 "General Duty Valves for HVAC Piping"

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.

3.07 WATER TREATMENT SEQUENCE

A. Pre-Treatment and Flush

1. This step should be done within 24 hour of the disinfection procedure.
2. Isolate existing piping from new piping so as to circulate solution in the newly installed pipe system ONLY.

3. Contractor shall provide valves and piping as necessary to bypass the existing water systems.
4. Add sufficient neutral-based cleaner, as recommended by the manufacturer, to the system and/or coils water, and circulate for 24-36 hours at full flow.
5. Drain and refill and flush the system with city water for at least one (1) hour or until the rinse water is clean of any particulates or oil. Continue the flushing procedure until the water is equivalent to city water.
6. At the end of the cleaning, take and analyze water samples as noted in the notes section above.

B. Passivation

1. Start passivation at the end of the cleaning cycle, no longer than six (6) hours later.
2. Add the passivation chemical to the system and circulate for six (6) hours, but test after two (2) hours for nitrate or molybdate and azole levels to ensure the required levels are reached, as shown in the notes section above. If the levels are below the required levels, then add additional chemicals and retest in another two (2) hours. Repeat until the proper levels are reached. Once the proper levels are reached, circulate for six (6) hours.
3. At the end of passivation, take and test water samples for the nitrate or molybdate and azole levels.
4. Once approved, the new system and/or coils may be tied into the campus TES chilled water and/or heating hot water system.

C. Inhibitor

1. Start inhibitors at the end of the cleaning cycle, no longer than six (6) hours later.
2. Add the inhibitors chemical to the system and circulate for six (6) hours, but test after two (2) hours inhibitor levels. If the levels are below the required levels, then add additional chemicals and retest in another two (2) hours. Repeat until the proper levels are reached.
3. After adding inhibitor, take and test water samples for the nitrate or molybdate and azole levels.

D. Once approved, the new system and/or coils may be tied into the campus chilled water and/or heating hot water system.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
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.

1.02 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.

D. Air distribution systems shall be fully ducted from the equipment to the air inlets and outlets. Open-air/return plenum systems are prohibited.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.
3. Seismic-restraint devices.

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.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.04 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.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

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

2.01 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."

2.02 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. 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.

D. 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.

E. 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."

2.03 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.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated on the “Duct Schedule” Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the “Duct Schedule” Article.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. 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.

G. 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.

2.04 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. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. 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.

2.05 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. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. 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).
11. 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."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
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.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.

8. 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).
9. VOC: Maximum 395 g/L.
10. 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."
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
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."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-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.

2.06 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:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.07 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.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers as required by NFPA 90A. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class B.
4. Outdoor, Return-Air Ducts: Seal Class A.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 1-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class B.
8. Unconditioned Space, Return-Air Ducts: Seal Class A.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 1-Inch wg and Lower: Seal Class B.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1-Inch wg: Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class A.
12. Conditioned Space, Return-Air Ducts: Seal Class A.

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: 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," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with [SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems"] [OSHPD Preapproved Manufacturer's Certification (OPM)].

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect 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. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections**,** selected by Engineer from sections installed**,** totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

D. Contractor shall develop and implement an IAQ Management Plan for the construction and preoccupancy phases of the building as follows:

1. During construction meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines

for Occupied Buildings Under Construction, and Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).
2. Protect stored materials on-site and installed absorptive materials from moisture damage.
3. If permanently installed air handlers are used during construction, then filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-2012 (with errata, but without addenda). Replace air filtration media immediately prior to occupancy.

E. Duct system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.09 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Laboratory Exhaust Ductwork: 316 Stainless Steel

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 1-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 2.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

    a. Pressure Class: Negative 2-inch wg.
    b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 2.

2. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

    a. Type 316L, stainless-steel sheet.

        1) Exposed to View: No. 4 finish.
        2) Concealed: No. 2D finish.

    b. Pressure Class: Positive or negative 4-inch wg.
    c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    d. SMACNA Leakage Class: 3.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 3-inch wg.
    b. Minimum SMACNA Seal Class: A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 2.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 2.

2. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 2.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminum.

G. Liner:

1. Supply Air Ducts: Fibrous glass, Type I 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I 1 inch] thick.
3. Supply Fan Plenums: Fibrous glass, Type II 1 inch thick.
4. Return Fan Plenums: Fibrous glass, Type II 1 inches thick.
5. Transfer Ducts: Fibrous glass, Type 1-1/2 inches thick.

H. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 2 inches thick.
2. Return Air Ducts: 2 inches thick.
3. Exhaust Air Ducts: 2 inches thick.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Mitered Type RE 4 with single-thickness turning vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and single-thickness turning vanes.
3) Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.5 radius-to-diameter ratio and single-thickness turning vanes.
3) Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and single-thickness turning vanes.
c. Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 10 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 12 Inches and Larger in Diameter: Welded.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Taps shall be the more stringent of what is shown on the mechanical drawings and the criteria listed below. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 900 fpm or Lower: 90-degree tap.
b. Velocity 901 to 1500 fpm: Conical tap.

c. Velocity 1501 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 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.

1.02 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.

1.03 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.
    b. Manual volume damper installations.
    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.

1.04 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.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 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 - GENERAL

2.01 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.

2.02 REMOTE DAMPER OPERATORS

A. Manufacturer:

1. Young Regulator
2. Approved Equal.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover Plate Material: Stainless Steel.

2.03 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.

2.04 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).

2.05 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.

2.06 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.

2.07 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.

2.08 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:

1. National Fire Protection Association NFPA Standard 90A, 92A, 92B and 101
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.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. To minimize duct noise generated by volume dampers, SMACNA recommends locating dampers at least two duct diameters from fittings and as far away as possible from outlets.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Coordinate subparagraphs below with Section 233113 "Metal Ducts."
2. Install steel volume dampers in steel ducts.
3. Install aluminum volume dampers in aluminum ducts.

F. Set dampers to fully open position before testing, adjusting, and balancing.

G. Install test holes at fan inlets and outlets and elsewhere as indicated.

H. Install fire and smoke dampers according to UL listing.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from backdraft dampers.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Control devices requiring inspection.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches
2. Two-Hand Access: 12 by 6 inches
3. Head and Hand Access: 18 by 10 inches
4. Head and Shoulders Access: 21 by 14 inches
5. Body Access: 25 by 14 inches
6. Body plus Ladder Access: 25 by 17 inches

L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Where indicated on Drawings, connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

R. Retain paragraph below for thrust limits on flexible connections for fans.

S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 33 46

FLEXIBLE DUCTS

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.

1.02 SUMMARY

A. Section Includes:

1. Non-insulated flexible ducts.
2. Insulated flexible ducts.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. 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 product.

C. Shop Drawings: For flexible ducts.

1. Include plans showing locations and mounting and attachment details.

1.04 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.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. 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.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.02 NON-INSULATED FLEXIBLE DUCTS

A. Manufacturers:

1. Thermaflex S-TL
2. Or submitted equal approved by the Engineer of Record.

B. Non-Insulated, Flexible Duct: UL 181, Class 1, coated woven fiberglass supported by helically wound, coated spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 6000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

2.03 INSULATED FLEXIBLE DUCTS

A. Manufacturers:

1. Thermaflex G-KM
2. JP Lamborn Co. MF-05
3. Or submitted equal approved by the Engineer of Record.

B. Insulated, Flexible Duct: UL 181, Class 1, GREENGUARD Gold Certified, black polymer film or coated fiberglass cloth fabric supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene fire retardant vapor-barrier film; factory installed collars.

1. Pressure Rating: 3-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: 0 to 160 deg F.
4. Insulation R-Value: R4.2.

2.04 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with stainless steel hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

B. For flexible duct connectors with metal collars, use minimum three sheet metal screws and duct sealer

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. As indicated on Drawings, connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

D. Connect flexible ducts to metal ducts with bands.

E. Install duct test holes where required for testing and balancing purposes.

F. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

G. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

SECTION 233423

HVAC FANS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

Section Includes:

1. Utility set fans.
2. Centrifugal roof ventilators.
3. Centrifugal wall ventilators.
4. Ceiling-mounted ventilators.
5. Square in-line centrifugal fans.
6. Tubular in-line centrifugal fans.
7. Propeller fans.
8. Mixed-flow fans

1.03 ACTION SUBMITTALS

01. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. 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.

Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Roof curbs.
9. Fan speed controllers.

Shop Drawings:

10. Include plans, elevations, sections, and attachment details.
11. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
12. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

Operation and Maintenance Data: For HVAC fans to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

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(s) for each belt-driven unit.

1.07 QUALITY ASSURANCE

Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

UL Standards: HVAC fans shall comply with UL 705. HVAC fans for use for restaurant kitchen exhaust shall also comply with UL 762.

1.08 COORDINATION

Coordinate size and location of structural-steel support members.

Coordinate sizes and locations of concrete bases with actual equipment provided.

Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

Provide access around equipment as specified on plans and/or according to manufacturer’s requirements.

1.09 WARRANTY

Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents

The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

Unusual Service Conditions

1. Base fan-performance ratings on the following:

    a. Ambient Temperature: 70 deg F.
    b. Altitude: 0 feet above sea level.

Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation and seismic restraints, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

Seismic Performance: HVAC power ventilators shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2. 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."
3. Component Importance Factor: [**1.5**]

2.01 UTILITY SET FANS

Manufacturers:

1. Greenheck Fan Company.
2. Loren Cook Company.
3. PennBarry
4. Twin City Fans

Housing: Fabricated of Stainless steel with side sheets fastened with a deep lock seam or welded to scroll sheets.

5. Housing Discharge Arrangement: Adjustable to eight standard positions.

Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

6. Blade Materials: Stainless Steel
7. Blade Type: Backward inclined

Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{10} of 80,000 hours

8. Extend grease fitting to accessible location outside of unit.

Belt Drives:

9. Factory mounted, with final alignment and belt adjustment made after installation
10. Service Factor Based on Fan Motor Size: 1.5.
11. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
12. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
13. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

Accessories:

14. Inlet and Outlet: Flanged.
15. Companion Flanges: Rolled flanges for duct connections of same material as housing.
16. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
17. Access Door: Gasketed door in scroll with latch-type handles.
18. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
19. Inlet Screens: Removable wire mesh.
20. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
21. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
22. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
23. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
24. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2.02 CEILING-MOUNTED VENTILATORS

Manufacturers:

1. Greenheck Fan Company.
2. Loren Cook Company.
3. PennBarry
4. Twin City Fans

Housing: Steel, lined with acoustical insulation.

Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.

Back-draft damper: Integral.

Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.

Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

Accessories:

5. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
6. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
7. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
8. Motion Sensor: Motion detector with adjustable shutoff timer.
9. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless steel springs, and fusible link.
10. Filter: Washable aluminum to fit between fan and grille.
11. Isolation: Rubber-in-shear vibration isolators.
12. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.03 MOTORS

Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. 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.

2.04 SOURCE QUALITY CONTROL

Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by an NRTL, and marked for intended location and application.

AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

Operating Limits: Classify according to AMCA 99.

UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.01 INSTALLATION

Install HVAC fans level and plumb.

Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

Ceiling Units: Suspend units from structure per Drawings.

Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Install units with clearances for service and maintenance of fans, motors and all other components that may need access

Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

Install ducts adjacent to HVAC fans to allow service and maintenance.

Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

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.

Tests and Inspections:

2. Verify that shipping, blocking, and bracing are removed.

3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Prepare test and inspection reports.

3.04 ADJUSTING

Adjust damper linkages for proper damper operation.

Adjust belt tension.

Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

Replace fan and motor pulleys as required to achieve design airflow.

Lubricate bearings.

END OF SECTION 233423

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

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.

1.02 SUMMARY

A. Section Includes:

1. Architectural plaque diffusers.
2. Perforated diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. 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 product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.04 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-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
2. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 ARCHITECTURAL PLAQUE DIFFUSERS

A. Manufacturers:

1. Titus OMNI.
2. Krueger.
3. Price Industries.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel

D. Finish: Baked enamel, white

E. Face Style: Refer to Drawings.

F. Mounting: T-bar

G. Pattern: Adjustable.

H. Accessories:

1. Equalizing grid.
2. Plaster ring.
3. Safety chain.
4. Wire guard.
5. Sectorizing baffles.
6. Operating rod extension.

2.02 PERFORATED DIFFUSERS

A. Manufacturers:

1. Titus PAR
2. Krueger.
3. Price Industries.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel backpan and pattern controllers, with steel face.

D. Finish: Baked enamel, white.

E. Duct Inlet: Refer to Drawings.

F. Face Style: Refer to Drawings.

G. Mounting: T-bar

H. Pattern Controller None

I. Accessories:

1. Equalizing grid.
2. Plaster ring.
3. Safety chain.
4. Wire guard.
5. Sectorizing baffles.
6. Operating rod extension.

2.03 ACCESSORIES

A. Flexible Duct Support

1. Manufacturers: Titus FlexRight (no known equal)

a. Radius forming brace to support 4-inch through 16-inch diameter flexible air ducts.
b. Provide nylon cable ties to secure flex duct to FlexRight brace.

2.04 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center

of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Install Titus FlexRight brace at all flexible duct-to-diffuser connections.

3.03 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 52 16

CONDENSING BOILERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes gas-fired, water-tube condensing boilers, trim, and accessories for generating hot water.

1.02 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.

1.03 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.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.05 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

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, 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.

2.02 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.

C. Heat Exchanger: Finned-copper primary and stainless-steel secondary heat exchangers.

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.
3. Finish: Textured epoxy.
4. Insulation: Minimum 2-inch thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.

K. Capacities and Characteristics: See schedule on plans.

2.03 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.

E. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

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.

2.04 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. Monitoring: On/off status, common trouble alarm and low-water-level alarm.
c.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.

2.05 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.

2.06 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.

2.07 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

3.01 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 BOILER INSTALLATION

A. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s).

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

I. Boiler Venting:

1. Install flue venting kit and combustion-air intake.

J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and **water temperature**.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Boiler will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

G. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.
    b. Test for boiler efficiency per manufacturer’s recommendations. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.

5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
7. Notify Architect and Engineer 48 hours minimum in advance of test dates.
8. Document test results in a report and submit to Architect.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION

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SECTION 23 65 14.16

CLOSED-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes factory-assembled, closed-circuit, induced-draft, counterflow cooling towers.

1.02 DEFINITIONS

A. SCCR: Short-circuit current rating.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, pressure drop, fan performance data, rating at selected points indicated, and furnished specialties and accessories.
2. Maximum flow rate.
3. Minimum flow rate.
4. Pressure required at cooling tower supply piping connections.
5. Pressure required at collection basin sweeper supply piping connections.
6. Drift loss as percent of design flow rate.
7. Volume of water in suspension for purposes of sizing remote storage.
8. Sound:

    a. Sound pressure levels for operation with fan off, fan at minimum speed, and design speed. If sound requirements are indicated at a specific distance, submit performance using same distance for comparative analysis.
    b. Sound power levels in eight octave bands for operation with fans off, fans at minimum speed, and design speed.

9. Fan airflow at design conditions, brake horsepower, and drive losses (indicated in horsepower and percent of brake horsepower).
10. Fan motor electrical characteristics including, but not limited to, speed, voltage, phase, hertz, amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
11. Pump flow rate, head, brake horsepower, and efficiency.
12. Pump motor electrical characteristics including, but not limited to, speed, voltage, phase hertz, amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
13. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings:

1. Manufacturer's drawings of assembled cooling towers, control panels, sections, and elevations.

2. Assembled unit dimensions.
3. Diagram showing each separate piece requiring field assembly.
4. Shipped sub-assembly dimensions and weights for field assembly.
5. Assembled unit weight without water.
6. Operating weight and load distribution.
7. Unit vibration isolation and seismic controls.
8. Required clearances for maintenance and operation.
9. Sizes and dimensioned locations of piping and wiring connections.
10. Diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For cooling tower support structure 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 support structure.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Drawings on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   a. Structural supports.
   b. Piping roughing-in requirements.
   c. Conduit and wiring roughing-in requirements for controls and electrical power, including spaces reserved for controls and electrical equipment.
   d. Access requirements, including working clearances for controls and electrical equipment, and service clearances. Mark and label clearances.

2. Drawings showing plans, sections, and elevation views, drawn to scale of at least ¼” = 1’-0”.
3. Each view to show screened background with the following:

   a. Structural grids.
   b. Adjacent walls, floors, and roofs.
   c. Equipment and products of other trades that are located in vicinity of cooling towers and are part of final installation, such as controls, power, lighting, fire-suppression systems, and plumbing systems.

B. Seismic Qualification Data: Certificates, for cooling towers, 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.

C. Product Certificates: For certification required in "Quality Assurance" Article.

D. Field Test Reports: Include startup service reports.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.

B. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Belts:

1. Furnish one set(s) of matching belts for each unique belt configuration and size furnished.

B. Touchup Coating: 32-oz. container of paint coating used. Label outside of container with detailed description of coating to allow for procurement of a matching coating in the future.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by CTI.

B. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. CTI Certification: Cooling tower thermal performance according to CTI STD 201RS.

D. FM Global: Approval and listing in the latest edition of FM Global's "Approval Guide."

1.08 DELIVERY, STORAGE, AND HANDLING

A. Coordinate requirements for multi-piece assembly for shipment. Limit the number of separate pieces for field installation to as few as possible.

B. If factory assembly of multiple pieces is required for testing or other reasons, disassemble cooling tower into major assemblies as required by installation before packaging for shipment.

1. Clearly label each separate package with a unique designation and include with assembly instructions for each complete cooling tower.

2. Install seals on gear-drive assemblies to eliminate oil leakage during shipment if shipped with oil.

1.09 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:

1. All components of cooling tower.
2. Fan assembly including fan, drive, and motor.
3. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Recold.

B. Approved Equal.

2.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Cooling tower and support structure shall withstand the effects of loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

B. Seismic Performance: Cooling towers 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."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

E. Vibration:

1. Rotating assemblies shall be dynamically balanced to achieve a balance level of "good" while complying with industry standard requirements for cooling towers.
2. Critical speed shall be at least 115 percent of design speed.

2.03 DESIGN ARRANGEMENT

A. Counterflow design with airflow from all sides and induced-draft, top-mounted axial fan and pressurized pipe distribution.

2.04 CASING AND FRAME

A. Casing Material: Stainless steel, Grade 300.

B. Frame Material: Stainless steel, Grade 300.

C. Hardware: Stainless steel.

D. Joints and Seams: Sealed watertight.

E. Welded Connections: Sealed watertight by continuous welds.

2.05 COLLECTION BASIN

A. Factory-Assembled Collection Basin:

1. Material: Stainless steel, Grade 300.
2. Hardware: Stainless steel.
3. Joints and Seams: Sealed watertight.
4. Welded Connections: Sealed watertight by continuous welds.
5. Removable stainless-steel strainer with openings smaller than nozzle orifices.
6. Overflow and drain connections.
7. Makeup-water connection.
8. Outlet Connection: Configured to mate to ASME B16.5, Class 150 flange.
9. Basin Sweeper Distribution Piping and Nozzles:

    a. Pipe Material: PVC, Schedule 40 or heavier, treated with UV inhibitors and intended for continuous exposure to direct sunlight with degradation.
    b. Nozzle Material: Plastic.
    c. Configure piping and nozzles to minimize sediment from collecting in the collection basin.
    d. Basin penetrations sealed watertight.
    e. Field Connections: Threaded or flanged depending on pipe size.

2.06 COLLECTION BASIN MAKEUP-WATER ASSEMBLY

A. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

B. Electric/Electronic, Collection Basin Water-Level Controller with Makeup-Water Valve:

1. Enclosures: NEMA 250, Type 4.
2. Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to control makeup-water valve.
3. Electrode Probes: Stainless steel.
4. Makeup-Water Valve:

    a. Slow closing with stainless-steel body.
    b. Valve actuator controlled and powered through level controller in response to water-level set point.
    c. Actuator Enclosure: NEMA 250, Type 4.

d. Fail Position: Last.
e. Action: Two position.

5. Electrical Connection Requirements: 120-V ac, single phase, 60 Hz.

2.07 PRESSURIZED DISTRIBUTION NETWORK

A. Main header and lateral branch piping designed for even distribution over heat-exchanger coils throughout the entire flow range without the need for balancing valves and for connecting individual, easily removable, nonclogging spray nozzles.

B. Pipe Material: Schedule 40 PVC.

C. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

2.08 HEAT-EXCHANGER COILS

A. Tube and Tube Sheet Materials: Copper tube with stainless-steel tube sheet with copper headers.

B. Heat-Exchanger Arrangement:

1. Serpentine tubes; sloped for complete drainage of fluid by gravity.
2. Tubes with extended surface fins if required to achieve performance indicated.
3. Multiple Separate Circuits: Separate circuits to achieve multiple isolated loops as required by application.

C. ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and bearing ASME "U" stamp; sloped for complete drainage of fluid by gravity.

D. Field Piping Connections: Vent, supply, and return suitable for mating to ASME B16.5, Class 150 flange.

2.09 DRIFT ELIMINATORS

A. Material: PVC; with maximum flame-spread index of 25 according to ASTM E84.

B. UV Treatment: Inhibitors to protect against damage caused by UV radiation.

C. Arrangement: Multiple, easily removable sections.

D. Configuration: Multipass, designed and tested to reduce water carryover to 0.001 percent of design flow rate indicated.

E. Hardware: Stainless steel.

2.10 AIR INLET

A. Air-Intake Louvers:

1. Material: PVC.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Multiple, easily removable sections arranged to uniformly direct air into cooling tower, to minimize air resistance, to block direct sunlight, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

B. Hardware: Stainless steel.

2.11 FAN AND DRIVE ASSEMBLY

A. Axial Fan: Balanced at the factory after assembly.

1. Blade Material: Aluminum or galvanized steel.
2. Hub Material: Aluminum or galvanized steel.
3. Blade Pitch: Field adjustable.
4. Fan Shaft: Corrosion resistant.
5. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 100,000 hours.
6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.
7. Automatic Bearing Greasing System:

    a. Manufacturer designed system to provide an as needed supply of new grease to bearings while reducing the need for periodic bearing maintenance and associated greasing problems.
    b. Easily replaceable storage container filled with recommended grease and located in an easily accessible location on cooling tower exterior. Container capacity of sufficient size to provide grease for one year.

B. Belt Drive:

1. Service Factor: 1.5 based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
3. Belt: One-piece, multigrooved, solid-back belt.
4. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
5. Belt-Drive Guard: Comply with OSHA regulations.

C. Fan Motor:

1. Comply with NEMA MG 1 unless otherwise indicated.
2. Description: NEMA MG 1, Design B, as required to comply with capacity and torque characteristics; medium induction motor.
3. 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.
4. Motor Enclosure: Open dripproof with weather protective cover.
5. Rotor: Random-wound, squirrel cage.
6. Energy Efficiency: NEMA Premium Efficient.
7. Service Factor: 1.15.

8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Variable-Speed Motors: Inverter-duty rated per NEMA MG 1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
11. Motor Location: Mounted outside of cooling tower casing and cooling tower discharge airstream.
12. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.
13. Motor Shaft Grounding: Motors shall be controlled through variable-frequency controllers with shaft grounding system to protect motor bearings from induced voltage. Drag on motor shaft due to shaft ground system shall be less than 0.5 percent of motor nameplate horsepower.

D. Hardware: Galvanized or stainless steel.

2.12 AIR DISCHARGE

A. Fan Discharge Stack:

1. Manufacturer's standard low-profile design.
2. Stack Extension: Fabricated to extend above fan deck as noted on plans.
3. Stack Termination: Wire-mesh, stainless-steel screens; segmented into multiple removable pie sections and complying with OSHA regulations.

    a. If not provided with factory controls, field-connect provisions for electrical power and controls to open dampers when pump is energized and close dampers when pump is de-energized.

2.13 RECIRCULATING WATER DISTRIBUTION SYSTEM

A. Pump: Close-coupled, single-stage, bronze-fitted centrifugal pump; with mechanical seal and suitable for outdoor service. Factory install pump with following:

1. Redundant Pump: Same performance as required for primary pump; easily switched and maintained while cooling tower remains operating.
2. Flanges at pump connections to piping.
3. Strainer, with blowdown isolation valve, installed in piping on suction side of pump.
4. Flow balancing valve in piping on discharge side of pump.

B. Pump Motor:

1. Comply with NEMA MG 1 unless otherwise indicated.
2. Description: NEMA MG 1, Design B, as required to comply with capacity and torque characteristics; medium induction motor.
3. 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.
4. Motor Enclosure: Open dripproof.
5. Rotor: Random-wound, squirrel cage.
6. Energy Efficiency: NEMA Premium Efficient.
7. Service Factor: 1.15.

8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.

2.14 ELECTRICAL POWER

A. Factory Install: A variable-frequency controller for each fan motor and a motor controller for each pump motor.

1. Locate in a convenient and field-accessible location within sight of motor.
2. Installation shall comply with CEC.

B. Variable-Frequency Controllers: Provide per specification 230514 “Variable Frequency Drives.”

2.15 WATER TREATMENT

A. Chemical Water Treatment System: Complete factory-installed system consisting of the following:

1. Microprocessor-controlled conductivity controller housed in NEMA 250, Type 4X enclosure.
2. Chemical metering pump housed in NEMA 250, Type 4X enclosure.
3. Electrically operated valve designed to control totally dissolved solids levels and bleed rates.
4. Piping associated with system.
5. Interconnecting power and control wiring installed in corrosion-resistant metal raceway.

2.16 SERVICE ACCESS

A. Doors:

1. Large enough for personnel to access cooling tower internal components.
2. Doors shall be hinged with handles operable from both sides of the door.
3. Door materials shall match casing.
4. Hinges and handles shall be [corrosion resistant] [stainless steel] <Insert material>.

2.17 SOURCE QUALITY CONTROL

A. Performance Test: Factory test and certify cooling tower performance according to CTI STD 201RS, "Standard for the Certification of Water-Cooling Tower Thermal Performance."

1. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

B. Factory Functional Tests:

1. Test collection and distribution basins after assembly, and prove free of leaks.
2. Test factory-installed electric/electronic water-level controls for proper operation.
3. Test factory-installed electric basin heaters for proper operation.
4. Test factory-installed fan and drive assemblies for proper operation.

5. Test factory-installed control package for proper operation.
6. Test access doors to ensure smooth operation and proper fit.
7. Submit report documenting tests performed and results within one week of test date.

C. Heat-Exchanger Factory Pressure and Leak Tests:

1. Pneumatically test heat-exchanger assembly while submerged underwater and prove to be free of leaks.
2. Submit report documenting test and results.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine cooling towers before installation. Reject cooling towers that are damaged.

B. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting cooling tower performance, maintenance, and operation.

1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
2. Verify sizes and locations of concrete bases and support structure with actual equipment.
3. Verify sizes, locations, and anchoring attachments of structural-steel support structures.
4. Verify sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install cooling towers on support structure.

B. Equipment Mounting:

1. Install cooling towers on cast-in-place concrete equipment bases.
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Maintain clearances required by governing code.

F. Loose Components: Install components, devices, and accessories furnished by manufacturer with cooling tower, that are not factory mounted.

1. Loose components shall be installed by Contractor under supervision of manufacturer's

factory-trained service personnel.

3.03 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to cooling towers, allow space for service and maintenance.

C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

D. Install drain piping with valve at cooling tower drain connections and at low points in piping.

E. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

F. Makeup-Water Piping:

1. Comply with applicable requirements in Section 221116 "Domestic Water Piping."
2. Connect to makeup-water connections with shutoff valve, plugged tee with pressure gage, and drain connection with valve and union.

G. Supply and Return Piping:

1. Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
2. Connect to entering cooling tower connections with shutoff valve, strainer, balancing valve, thermometer, plugged tee with pressure gage, and drain connection with valve.
3. Connect to leaving cooling tower connection with shutoff valve thermometer, plugged tee with full port ball valve for portable field instruments, and drain connection with valve.
4. Make connections to cooling tower with a flange.

H. Basin Sweeper Piping:

1. Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
2. Connect to supply connections with shutoff valve and drain connection with valve.
3. Connect to return connections with shutoff valve, balancing valve, and drain connection with valve.
4. Make connections with a flange or union.

3.04 ELECTRICAL POWER CONNECTIONS

A. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.

B. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

C. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.

D. Install nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.05 CONTROLS CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between cooling towers and other equipment to interlock operation as required to achieve a complete and functioning system.

C. Connect control wiring between cooling tower control interface and DDC system for remote monitoring and control of cooling towers. Comply with requirements in Division 25.

D. Install label at each termination indicating control equipment designation serving cooling tower and the I/O point designation for each control connection. Comply with requirements in Section 260553 "Identification for Electrical Systems" for labeling and identification products and installations.

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections: Comply with CTI ATC 105.

D. Cooling towers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.07 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping; controls; and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

   a. Clean entire unit including basins.
   b. Verify that accessories are properly installed.
   c. Verify clearances for airflow and for cooling tower servicing.
   d. Check for vibration isolation and structural support.
   e. Lubricate bearings.
   f. Verify fan rotation for correct direction and for vibration or binding and correct prob-

lems.

g. Verify pump rotation for correct direction, vibration, cavitation, and flow and correct problems.
h. Adjust belts to proper alignment and tension.
i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
j. Check vibration switch setting. Verify operation.
k. Verify water level in tower basin. Fill to proper startup level. Check makeup-water-level control and valve.
l. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
m. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.08 ADJUSTING

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

C. Adjust basin heater control for proper operating set point.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

1. Video record the training sessions.
2. Instructor shall be factory trained and certified.
3. Perform not less than 8 hours of training.
4. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
5. Perform instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
6. Obtain Owner sign-off that training is complete.
7. Owner training shall be held at Project site.

END OF SECTION

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.02 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.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.05 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.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, 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.

1.07 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.08 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

2.01 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 (BOD)
2. Fujitsu
3. LG

2.02 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. Provide external secondary drain pan.
    b. 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. Single-wall, stainless-steel sheet.
    d. 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: 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.

2.03 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.
4. Motor: NEMA rated class F suitable for operation in a refrigerant atmosphere. Totally enclosed single phase motor with class B insulation and permanently lubricated bearings. Motor shall be protected by internal thermal overload protection.
5. Low Ambient Kit: Permits operation down to 25 deg F (7 deg C).
6. Mounting Base: Polyethylene.
7. Outdoor coil: Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed. Coils shall be coated for corrosion resistance. Cathodic epoxy type electro-disposition coating formulated for high edge build to plate fin and tube heat exchangers. Coating shall provide excellent resistance and durability to corrosive effects of alkalies, acids, alcohols, petroleum, seawater, salt air and corrosive environments.

2.04 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.
5. Wireless thermostats are not permitted.

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

3.01 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.

G. Provide a secondary drain pan for units located in data rooms, electrical rooms, or similar critical spaces.

3.02 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.

3.03 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.

3.04 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 23 81 46

WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes unitary heat pumps with refrigerant-to-water heat exchangers, refrigeration circuits, and refrigerant compressor(s).

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each water-source unitary heat pump.

C. Include rated capacities, operating characteristics, furnished specialties, and accessories.

D. Shop Drawings:

E. Include plans, elevations, sections, and mounting and attachment details.

F. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

G. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For water-source unitary heat pumps, accessories, and components, from manufacturer.

B. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

C. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of water-source unitary heat pump, signed by product manufacturer.

F. Field quality-control reports.

G. Sample Warranty: For manufacturer's warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water-source unitary heat pumps to include in emergency, operation, and maintenance manuals.

1.05 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water-source unitary heat pumps that fail in materials or workmanship within specified warranty period.

B. Failures include, but are not limited to, refrigeration components.

C. Warranty Period: Four years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

B. ASHRAE 15.

C. Comply with CEC.

D. Comply with safety requirements in UL 484 for assembly of free-delivery, water-source heat pumps.

2.02 WATER-SOURCE UNITARY HEAT PUMPS, 6 TONS AND SMALLER

A. Manufacturer’s:

1. TRANE(Basis of Design)
2. ClimateMaster,
3. or approved equal.

B. Description: Packaged water-source unitary heat pump with temperature controls; factory assembled, piped, wired, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

D. Cabinet and Chassis: Galvanized-steel casing with the following features:

E. Access panel for access and maintenance of internal components.

F. Knockouts for electrical and piping connections.

G. Cabinet Insulation: Glass-fiber liner, minimum 1/2-inch-thick, complying with UL 181, ASTM C1071, and ASTM G21.

H. Water Circuits:

I. Refrigerant-to-Water Heat Exchangers:

1. All units shall contain an HFC-410A sealed refrigerant circuit including a high efficiency scroll or rotary compressor designed for heat pump operation, a thermostatic expansion valve for refrigerant metering, an enhanced corrugated aluminum lanced fin and rifled copper tube refrigerant to air heat exchanger, reversing valve, coaxial (tube in tube) refrigerant to water heat exchanger, and safety controls including a high pressure switch, low pressure (loss of charge) switch, water coil low temperature sensor, and air coil low temperature sensor. Access fittings shall be factory installed on high- and low-pressure refrigerant lines to facilitate field service. Activation of any safety device shall prevent compressor operation via a microprocessor lockout circuit. The lockout circuit shall be reset at the thermostat or at the contractor supplied disconnect switch. Units that cannot be reset at the thermostat shall not be acceptable.
2. The compressor shall have a dual level vibration isolation system. The compressor will be mounted on specially engineered sound-tested EPDM vibration isolation grommets or springs to a large heavy gauge compressor mounting plate, which is then isolated from the cabinet base with rubber grommets for maximized vibration attenuation. Compressor shall have thermal overload protection. Compressor shall be located in an insulated compartment away from air stream to minimize sound transmission.
3. Refrigerant to air heat exchangers shall utilize enhanced corrugated lanced aluminum fins and rifled copper tube construction rated to withstand 625 PSIG (4309 kPa) refrigerant working pressure. Refrigerant to water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 625 PSIG (4309 kPa) working refrigerant pressure and 500 PSIG (3445 kPa) working water pressure. The refrigerant to water heat exchanger shall be “electro-coated” with a low cure cathodic epoxy material a minimum of 0.4 mils thick (0.4 – 1.5 mils range) on all surfaces. The black colored coating shall provide a minimum of 1000 hours salt spray protection per ASTM B117-97 on all external steel and copper tubing. The material shall be formulated without the inclusion of any heavy metals and shall exhibit a pencil hardness of 2H (ASTM D3363-92A), crosshatch adhesion of 4B-5B (ASTM D3359-95), and impact resistance of 160 in-lbs (184 kg-cm) direct (ASTM D2794-93).

J. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

K. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.

L. Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.

M. Compressor:

1. Scroll.
2. Installed on vibration isolators and mounted on a structural steel base plate and full-length channel stiffeners.
3. Exterior of compressor shall be wrapped with a high-density sound-attenuating blanket and housed in an acoustically treated enclosure.
4. Factory-Installed Safeties:
5. Antirecycle timer.

6. High-pressure cutout.
7. Low-pressure cutout or loss of charge switch.
8. Internal thermal-overload protection.

9. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.

N. Water-coil, low-temperature switch.

O. Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.

P. Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E84.

Q. Refrigerant Metering Device: Thermal-expansion valve.

R. Controls: Control equipment and sequence of operation are specified in Division 25

S. Controls:

1. Basic Unit Control Modes and Devices:
2. Unit shutdown on high or low refrigerant pressures.
3. Unit shutdown on low water temperature.
4. Low- and high-voltage protection.
5. Overcurrent protection for compressor.
6. Random time delay, three to 10 seconds, start on power-up.
7. Time delay override for servicing.
8. Control voltage transformer.
9. Water-coil freeze protection (selectable for water or antifreeze).
10. Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.
11. Ability to defeat time delays for servicing.
12. Digital display to indicate high pressure, low pressure, low voltage, and high voltage.
13. The low-pressure switch shall not be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
14. Remote fault-type indication at thermostat.
15. Selectable 24-V dc or pilot duty dry contact alarm output.
16. 24-V dc output to cycle a motorized water valve with compressor contactor.
17. Service test mode for troubleshooting and service.
18. Unit-performance sentinel warns when heat pump is running inefficiently.
19. Compressor soft start.

T. Thermostat:

1. Wall-Mounted Thermostat:
2. Deg F indication.
3. Wall-mounted temperature sensor.
4. Duct-mounted temperature sensor
5. Unoccupied period override push button.
6. Digital display to indicate fault condition at heat pump.

7. Data entry and access port.
8. Input data include room temperature and humidity set points for occupied and unoccupied periods.
9. Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

U. Terminal Controller:

1. Scheduled operation for occupied and unoccupied periods on seven-day clock with minimum of four programmable periods per day.
2. Two-hour unoccupied override period.
3. Remote-control panel to contain programmable timer and digital display for fault condition.
4. Compressor-disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.
5. Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.
6. Backup for volatile memory.
7. DDC interface requirements as further described in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
8. Interface relay for scheduled operation.
9. Interface relay to provide indication of fault at central workstation.
10. Provide BAC-net interface for central DDC workstation for the following functions:
11. Set-point adjustment.
12. Start/stop and operating status of heat-pump unit.
13. Data inquiry to include supply-air and room-air temperature and humidity and entering-water temperature.
14. Occupied and unoccupied schedules.

V. Electrical Connection: Single electrical connection with fused disconnect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine 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 piping and electric installations for water-source unitary heat pumps to verify actual locations of piping connections and electrical conduits before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Equipment Mounting:

1. Install water-source, unitary heat pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

2. Comply with requirements for vibration-isolation and seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration-isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

4. Suspend water-source, unitary heat pumps from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
5. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Section 230923 "Direct Digital Control (DDC) System for HVAC."

B. CONNECTIONS

1. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
2. Connect supply and return hydronic piping to heat pump with hose kits.

3. Install electrical devices furnished by manufacturer but not specified to be factory mounted.
4. Install piping adjacent to machine to allow space for service and maintenance.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following field tests and inspections:

1. After installing water to water heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Heat pumps will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Inspect for visible damage to unit casing.

D. Inspect for visible damage to compressor and coils.

E. Inspect internal insulation.

F. Verify that labels are clearly visible.

G. Verify that clearances have been provided for servicing.

H. Verify that controls are connected and operable.

I. Adjust vibration isolators.

J. Start unit according to manufacturer's written instructions.

K. Complete startup sheets and attach copy with Contractor's startup report.

L. Record superheat and subcooling during start-up.

M. Inspect and record performance of interlocks and protective devices; verify sequences.

N. Operate unit for an initial period as recommended or required by manufacturer.

O. Verify thermostat calibration.

P. Inspect controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.

3.05 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source unitary heat pumps.

END OF SECTION

SECTION 25 00 00

INTEGRATED AUTOMATION SYSTEMS (IAS) FOR HVAC

PART 1 - GENERAL

1.1 RELATED SPECIFICATIONS:

A. Section 250600 - Network Scheduling Software for HVAC

B. Section 250800 – Fault Detection and Diagnostics Software for HVAC

C. Section 251400 – IAS Network Controllers for HVAC

D. Section 251500 – IAS Software and Programming Tools for HVAC

E. Section 259500 – Integrated Automation Control Sequences for HVAC

1.2 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:
1. Project Specific Scope of Work
2. General IAS Installation Scope of Work
3. Codes, Reference Standards, Definitions and Abbreviations
4. Quality Assurance

1.3 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 integration of the Campus' scheduling software into the IAS. Refer to Section 25 06 00.

D. Provide Fault Detection and Diagnostics for all equipment through the Districts preferred

FD&D software. Refer to Section 250800.

E. 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.

F. Provide point naming and tagging for all hardware and logical control points and equipment provided under this project in accordance with the District standard. Refer to Guideline B.

G. It is the contractor's responsibility to review all of the design documents and specifications and report any discrepancies to the District.

1.4 GENERAL IAS INSTALLATION SCOPE OF WORK

A. The IAS components shall utilize JACE 8000 network controllers listed as a sole source product in the District's design and construction standards, 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. 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.

F. 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.

G. 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.

H. 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.

I. Training of facility personnel, and or maintenance contractor, on the operation and maintenance of the system as called out in these specifications.

J. Hardware, Software and Labor as detailed and described on the IAS drawings and the Division 25 specifications.

K. 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.

L. DDC Controller programming and commissioning.

M. System point to point check out, verification and documentation.

N. 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.

O. The low voltage and communication raceway systems, wiring and terminations.

1.5 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 Integrated 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.

1.6 INSTALLER'S QUALIFICATIONS

A. Integration Firm Qualifications: The District's board of trustees approved the establishment of a pool of pre-qualified contractors to provide labor, work, services, materials, equipment and the like for integrated automation system projects district-wide. All IAS work shall be performed by one of the prequalified firms. These pre-qualified contractors are listed below:

1. Performance automation Solutions
   10633 Roselle Street Suite g,
   San Diego, CA 92121
   858-391-6407
2. Climatec
   13715 Stowe Drive
   Poway, CA 92064
   858-391-7001
3. Emcor Services Mesa Energy Systems
   900 Vernon Way
   El cajon, CA 92020
   619-980-2258

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. Installer's Experience with Proposed Product Line: The Firm must have a minimum of five (5) engineers or technicians that have successfully completed the Niagara certification course. Provide evidence of Niagara TCP certification as part of the submittal process. Proposed individuals must show proof of the following training:

1. 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.
2. 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).

1.7 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. Installer 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. Provide local San Diego or Orange County service department address which will support the District.

2. Proposed System Response Data: Provide guaranteed response times with Shop Drawings including calculations to support the guarantee.

3. Point to Point Checkout Procedures: Provide written procedures and sample test forms for contractor testing specified herein.

C. Construction Submittals

1. Contractor Testing Reports

a. Point to Point Checkout Sheets: Submit results from Contractors testing specified herein. Submittal shall be signed by the contractor verifying that all testing has been completed and issues have been resolved.

b. HVAC System startup and TAB reports.

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.

1.8 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
5. Network Management, Configuration, Controller/System Programming 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 a standard Web browser 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.

1.9 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:

E. 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.
1. Schematic drawings and details to supplement the descriptions.
2. A list of the contract requirements that must be revised if the change is accepted, including any suggested specification revisions.
3. Complete list of materials and equipment proposed for use in the change.
4. Include a description and estimate of costs Owner may incur in implementing the change, such as test, evaluation, operating and support costs.
5. A projection of any effects the proposed change would have on collateral costs to the Owner.
6. 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.
7. 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- BACnet
9. EMC Directive 89/336/EEC (European CE Mark

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, BACnet – A Data Communication Protocol for Building Automation and Control Networks
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. American Society for Testing and Materials (ASTM)
5. American Refrigeration Institute (ARI)
6. EIA-709.1-A-99: Control Network Protocol Specification
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. California Electrical Code (CEC)
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 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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.

3.7 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

3.8 CONTRACTOR TESTING

A. Point to Point Checkout Requirements:
   1. These procedures will verify the following for each physical control point
      a. Field Device is installed per the manufacturer's recommendations and the project drawings and specifications
      b. Field verify calibration of all analog inputs and outputs
      c. Verify labelling of controllers, field devices, and wiring
      d. Physical points are correctly addressed and communicating properly between its controller and the field device
   2. Detailed written procedures for execution of Point-to-Point checkouts shall be submitted by the contractor for review and acceptance prior to the start of testing. Include proposed test forms as part of this submittal.
   3. The contractor shall provide all tools and instrumentation necessary for execution of this testing. All instrumentation must be in calibration.
   4. The contractor shall sign and submit all final reports confirming that Point-to-Point testing was conducted, and all issues have been resolved. Owner functional testing shall not proceed until all contractor test reports have been submitted.

3.9 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

1.1 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. 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
4. Section 251500 – IAS Software and Programming Tools for HVAC

1.2 SUMMARY

A. The existing campus 25Live 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 installed on a Windows server platform and will 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 during normally occupied periods.

1.3 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. 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 25Live scheduling software.

PART 2 - PRODUCTS

2.1 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.

2.2 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: The interface software will support the following reservations systems and multiple instances of the same type of system
1. CollegeNet Resource25/25Live web services
2. Ad Astra Information Systems
3. eSPACE
4. Asure ResourceScheduler
5. ShelbyNext
6. SimpleChurchCRM
7. FellowshipOne Go
8. Microsoft Exchange (via Room Resources)
9. Google (G Suite) Business Calendar (via Room Resources)
10. Google Personal Calendar
11. Manual schedule import using CSV format
12. 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 can be associated with a single HVAC equipment item or zone
5. Multiple reservation systems or instances of reservation systems can be queried for control of zones
6. User defined password-based, role-based security
7. Software shall be generate the following reports on demand or in PDF format
8. Daily event report
9. Daily equipment command report
10. Room Assignment report
11. Equipment Detail report
12. Software shall be email users if any scheduled commands fail to get executed

13. Software shall email users the Daily reports above
14. Software can aggregate multiple reservation systems and multiple instances of a reservation system into common HVAC schedules
15. 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

3.1 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.

3.2 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 OF SECTION 25 06 00

SECTION 25 08 00

FAULT DETECTION AND DIAGNOSTICS (FDD)

PART 1 - GENERAL

1.1 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 – Integrated Automation System (IAS) for HVAC
2. Section 250600 – Network Scheduling Software for HVAC
3. Section 251400 – IAS Network Controllers for HVAC
4. Section 251500 – IAS Software and Programming Tools for HVAC
5. Guideline B – IAS Point Tagging Requirements

1.2 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

1.3 QUALITY ASSURANCE

A. Installing Company Qualifications

1. Experience in completing a minimum of three local projects of similar size with the type of FD&D system specified for this project within the last five years.

1.4 SUBMITTALS

A. Preconstruction Submittals

1. 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.

2. Shop Drawings: Shall include the following:

   a. Product data.

3. FD&D Sequence of Operations: A complete written Sequence of Operation describing each fault rule and its programming.

B. Construction Submittals

1. Point Validation Log: Log of tests conducted verifying 100% of the input and output points of the FD&D system operation. Contractor shall sign log indicting all issues have been addressed and system is ready for owner witness testing.

2. Standard Reports: Provide all standard reports including all time data and duration of all faults for a minimum of 72hours.

C. Closeout Submittals

1. Training Manuals

2. O&M Data

1.5 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

2.1 MANUFACTURERS

A. The fault detection and diagnostics software shall be based on SkySpark from SkyFoundry, fully integrated into the DGLux graphical user interface using Skyspark's REST-based API which the DGLux software can use. SkySpark is listed as a sole-source product 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.

2.2 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 Skyspark is currently hosted offsite by Ecovox. Due to offsite hosting, the bidding IAS contractor will not have direct access to the hosting server. Contact Ecovox for details – (805)540-2044. Provider shall include 60 months of software subscription for additional points 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.

2.3 HARDWARE REQUIREMENTS

A. The FD&D software shall reside on the DDC server.

2.4 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 – Boiler System

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 – Closed Circuit Cooling Tower Plants

1. The following rules shall be applied to all air cooled chilled water plants:
    a. Condenser Water DP Setpoint Not Met
    b. Condenser Water Leaving Temp Setpoint Not Met
    c. CW Pump Issue - Speed Too High
    d. Pump Speed above 90% 30 min
    e. Primary CHW Flow Sensor Failure
    f. Condenser Water Entering Temp Sensor Failure
    g. Condenser Water Flow Sensor Failure
    h. Condenser Water leaving Temp Sensor Failure
    i. Cooling Tower Status Doesn't Match Command
    j. Constant VFD Speed
    k. Chilled Water DP Setpoint Not Met
    l. Pump Speed Override
    m. Pump Speed Doesn't Match Command
    n. Pump Off When Commanded On
    o. Pump On When Commanded Off
    p. CW GPM/Ton Low
    q. CW GPM(Ton High)
    r. CW low Delta T
    s. Cooling Tower issue - Peak Demand
    t. CW Plant Efficiency

u. CW Supply temp set-point optimization
v. CW abnormal pump current
w. CW broken valves and sensors
x. CW equipment short-cycling

D. Custom Rule Development –Water Source Heat Pumps

1. The following rules shall be applied to all fan coils:
   a. Analog Damper Control Oscillation
   b. Low Temp Drop Across Cooling Coil
   c. Cooling Capacity Not Met
   d. DAT Hunting
   e. Condenser Water Valve Out of Range
   f. Zone Air Temp Sensor Failure
   g. Supply Air Temp Too Warm
   h. Supply Fan Off When Commanded On
   i. Supply Fan On When Unoccupied
   j. Supply Fan On When Commanded Off
   k. CW Valve Doesn't Match Command
   l. Condenser Water Valve leak
   m. Terminal Broken sensors
   n. Terminal Poor scheduling
   o. Terminal Poor Temperature Set Points

2.5 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

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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 25 08 00

SECTION 25 11 00

IAS INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

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. Related Specifications:
1. Section 250000 – Integrated Automation Systems (IAS) For HVAC
2. Section 251400 – IAS Network Controllers for HVAC
3. Section 251500 – IAS Software and Programming Tools for HVAC

1.2 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 & Actuators
3. Temperature Sensors
4. Occupancy Sensors
5. Differential Pressure Sensors
6. Current Sensing Relays
7. Current Transformers
8. Water Service Meter
9. Control Relays
10. Electrical Power Meters
11. Natural Gas Meters
12. Water Level Sensors
13. Vibration Switches
14. Zone Presence Sensor

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.

1.3 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.
      1) Control Valves & Actuators
      2) Temperature Sensors
      3) Occupancy Sensors
      4) Differential Pressure Sensors
      5) Current Sensing Relays
      6) Current Transformers
      7) Magnetic Flow Meter for Water Service
      8) Control Relays
      9) Electrical Power Meters
      10) Natural Gas Meters
      11) Water Level Sensors
      12) Vibration Switches
      13) Zone Presence Sensor
   b. Submit detailed cut sheets indicating the features, accessories and sub-assemblies of the following, or similar, as required:
   c. All ancillary devices including temperature sensors, flow sensors, and the like, including thermal wells where necessary
   d. Pressure gauges, thermometers and indicating devices where shown on the drawings
   e. Transformers required for control devices
   f. Relays
   g. Electrical enclosures and back-plates
   h. Wire for DLN, FAC LAN, and all sensors and actuators
   i. FAC LAN Hub(s), Switches, and Routers
   j. DLN Repeaters
   k. Gateway and interface devices
      1) Schedule of control dampers including leakage and flow characteristics.
      2) Schedule of control valves including pressure drop, Cv, leakage, and flow characteristics.

1.4 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

2.1 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.

2.2 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:

Purpose	Function	Color
Primary Communications DLN	Field Device Communication	Red / Pink
Spare Primary Communication DLN	Field Device Communication	Yellow
Secondary Communications DLN	Equipment Integration	Orange
Spare Secondary Communication DLN	Equipment Integration	Purple
FACLAN	Enterprise Network	Dark Blue
Spare FACLAN	Enterprise Network	Green
Analog Points	I/O Wiring	White
Digital Points	I/O Wiring	White / Black Stripe
Emergency Power	Control power	Yellow / Black Stripe
24VAC	Control power	Gray

B. 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 Integrate with existing communication infrastructure as illustrated on the design drawings.

C. 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.

D. 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.

E. Signal Wiring: Contractor shall run all signal wiring in accordance with the latest edition of the National Electrical Code and Division 26.

F. 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.

G. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

H. 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.

I. 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.

J. Control Panels: Refer to section 25 14 00.

2.3 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: Two position and modulating control valves up to 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.

C. 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.
1. Temperature Rating: 25 degrees F minimum, 250 degrees F maximum
2. 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.
3. Valve Trim: Bronze; Stem: Polished stainless steel
4. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting
5. Plug: Brass, bronze or stainless steel, Seat: Brass
6. Disc: Replaceable composition or stainless steel filled PTFE
7. Ambient Operating Temperature Limits: -10 to 150 degrees F (-12.2 to 66 degrees C)
8. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
   a. Johnson Controls
   b. Honeywell
   c. Warren
   d. Belimo
   e. Approved equal

D. 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. Approved equal

E. 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

2.4 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).

C. Two Position Electric Actuators: Line voltage (120 volt, 24 volt) with spring return. Provide end switches as required.

D. Electronic Actuators: Provide actuators with spring return for two-position (24 volt), 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.

E. 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.

F. Manufacturer shall provide a 2 year unconditional warranty from date of substantial completion.

G. Sound levels for VAV actuators shall not exceed 45 dB.

H. Electronic overload protection shall protect actuator motor from damage. If damper jams actuator shall not burn-out. Internal end switch actuators are not acceptable.

I. Subject to compliance with requirements, approved manufacturers are as follows:
a. Distech
b. Belimo
c. Johnson Controls
d. Honeywell
e. Approved equal

J. Electric Control Valve Actuator General Requirements
1. 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.

2. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure.
3. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.
4. Enclosure: Actuator enclosure shall be a NEMA 4 epoxy coated metal enclosure, and shall have a minimum of two threaded conduit entries.
5. Limit Switches: Travel limit switches shall be UL approved. Switches shall limit actuator in both open and closed positions.
6. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
7. 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.
8. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
9. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
10. 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.
11. Ambient Conditions: Actuator shall be designed for operation from –140 to 150 degrees F ambient with 0 to 100 percent relative humidity.
12. Field selectable direction with field adjustable zero span.

K. 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).

2.5 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 Calculations	+/-1%

2.6 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.

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. Acceptable Manufacturers
   a. Distech Allure UNITOUCH is listed as a sole source product in the District's design and construction standards. Alternate products will not be considered.
2. Sensing element shall be thermistor (10K Ohm, Type II), +/- 0.1 degrees F accuracy at calibration point (10,000 Ohms @ 77 °F).
3. Sensing element shall be mounted in a plastic enclosure
4. Operating Temperature Range: -40 to 302 °F (-40 to 150 °C)
5. Operating Humidity Range: 0 to 90% RH non-condensing
6. Provide setpoint adjustment. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable or limited via the IAS.
7. Provide an occupancy override button on the room sensor enclosure. This shall be a momentary contact closure.
8. Provide current temperature setpoint and measurement indication via a backlit LCD or LED readout.
9. Provide unit/zone heating and cooling status via the backlit LCD or LED readout.
10. Submit sensor to Architect for aesthetic and finish approval prior to installation.
11. Provide an electrical junction box behind RTS and route all thermostat/low voltage cable within walls in rigid conduit.

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.
2. 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.
        3) Brine (salt solutions): marine grade stainless steel.

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.

2.7 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.
8. Electrical Enclosure: NEMA 4, 4X, 7, 9.
9. Approvals: FM, CSA.
10. Acceptable Manufacturers:
   a. Setra
   b. Honeywell
   c. Approved equal

2.8 CURRENT SENSING RELAYS (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 CS 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.
3. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication:
4. Range: 3.5 to 135 Amps
5. 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
6. Switch: Solid state, normally open, 0.1A @ 30VAC/DC
7. Frequency Range: 35 to 75 Hz
8. Trip Indication: LED
9. Approvals: UL, CSA
10. Max. Cable Size: 350 MCM
11. Acceptable Manufacturers:
    a. Veris Industries, Inc. H-904
    b. Approved equal

C. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CS 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

2.9 CURRENT TRANSFORMERS (CT)

A. The current transformers shall be designed to be installed or removed without dismantling the primary bus or cables.

B. 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.

C. The current transformers shall meet the following specifications:

1. Frequency Limits: 50 to 400 Hz
2. Insulation: 0.6 KV Class, 10 KV BIL
3. Accuracy: ± .2% at 5.0 to 25.0 VA accuracy class with U.P.F. burden
4. Range <1-10 Amps minimum, 20-200 amps> maximum
5. Trip Point adjustable
6. Output 0-5 VDC
7. Provide a disconnect switch for each current transformer
8. Protection: 250 A max current
9. Acceptable Manufacturers:
   a. Ohio, Semitronics Technologies Inc.
   b. Triad Technologies
   c. EMON
   d. Hawkeye
   e. Approved equal

2.10 WATER SERVICE METER

A. General Requirements:

1. Refer to plumbing plans and Division 22 specifications.

2.11 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. 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 l0E9 ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz. The contact life shall be 10 x 10 E6 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.
4. 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.
5. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
6. AC coil pull-in voltage range of +10 percent, -15 percent or nominal voltage.
7. Coil sealed volt-amperes (VA) not greater than four (4) VA.
8. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
9. Pilot light indication of power-to-coil and coil retainer clips.
10. Coil rated for 50 and 60 Hz service.

C. Acceptable Manufacturers:

1. Potter Brumfield, Model KRPA
2. Approved equal

D. Material: Gold Flash

E. Rating 10 amps at 120-277 VAC

F. Provide HOA switch except in smoke control applications.

G. 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.

H. 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.

I. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA 1 enclosure. Manufacturer shall be Square 'D', Cutler-Hammer, Westinghouse, or approved equal.

J. 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 CEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 enclosure.

K. Transformers shall be manufactured by <Westinghouse, Square 'D', Jefferson, or approved equal>.

L. 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.

2.12 ELECTRICAL POWER METERS

A. Advanced Digital Electrical meters shall meet the following requirements:
1. Meter accuracy specifications shall comply with ANSI C12.20 Class 0.2% to 0.5% accuracy at 25°C.
2. Meter shall be UL certified.
3. Meter accuracy shall be + 0.5% for power measurements.
4. Capability to measure and record 15 minute interval data.
5. Capable of monitoring of: phase voltages, phase currents, power consumption, power factor, harmonics, power quality and kVAR.
6. Meter shall be capable of either BACnet or MODBUS communication

B. Wall Mounted Power Meters
1. The meter shall be UL listed and CE marked.
2. Power meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.
3. Meter shall support 3 element wye, 2.5 element wye, 2 element delta, 4 wire delta systems.
4. The meter shall accept universal voltage input.
5. Surge withstand shall conform to IEEE C37.90.1.
6. The power meter shall meet IEC 62053-22 Class 2 reactive power and energy accuracy specifications.
7. The power meter shall meet both ANSI C12.20 .5% and IEC 62053-22 Class .5S real power and energy accuracy specifications.
8. The meter shall be user programmable for voltage range to any PT ratio.
9. Meter shall accept a burden of up to .36VA per phase, Max at 600V, 0.014VA at 120 Volts.
10. Meter shall be capable of BACnet communication
11. The meter shall be located in a dedicated NEMA wall panel, installed flush to the wall, with a clear hinged cover allowing remote display viewing.
12. The power meter shall perform the following measurements:
    a. Accumulated Real Energy (kWh) for each phase and total of all phases
    b. Accumulated Reactive Energy (kVARh) and Apparent Energy (kVAh) totals for all phases
    c. Net Present Demand for Real (kW), Reactive (kVAR) and Apparent (kVA) Power over a user-specified interval (block or sliding window)
    d. Maximum (Peak) Real (kW), Reactive (kVAR) and Apparent (kVA) Demand Intervals

e. Instantaneous Real (kW), Reactive (kVAR) and Apparent Power (kVA), by phase and in total
f. Current (amps) for each phase and average of all phases
g. Phase-to-phase voltage for each phase and average of all phase pairs
h. Phase-to-neutral voltage for each phase pair and average of all phases
i. Power factor for each phase and average of all phases
j. AC frequency

13. Acceptable Manufacturers:
a. Veris Industries.
b. Approved equal

C. Current and Potential Transformers

1. Current Transformers shall conform to the following requirements:
a. 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.
b. Frequency: Nominal 60 Hz
c. Burden: Burden Class shall be selected for the load
d. Phase Angle Range: 0 to 60 degrees
e. 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.
f. 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.
g. 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.

D. Miscellaneous

1. Within one year after acceptance of Work, verify operation and recalibrate each meter in accordance with the manufacturer's written instructions.
2. 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.

2.13 NATURAL GAS METERS

A. General Requirements

1. Refer to plumbing plans and Division 22 specifications.

2.14 WATER SUBMERSIBLE LEVEL SENSOR

A. Water level sensors shall be hermetically sealed, vibration resistant

B. Output: 4-20 MA

C. Accuracy: +/-0.25%

D. Stem and float material: stainless steel

E. Allowable temperature range: -40°F to 392°F

F. Allowable pressure: 100psig

G. Required Accessories:

1. Submersible Level Transmitter Aneroid Bellows

2. Junction Box for Aneroid Bellows and terminal strip

3. Battery or power supply for 4-20ma output

H. Install switch at recommended low water level height per manufacturer recommendation

I. Acceptable Manufacturers:
1. Pro-sense SLT
2. Approved equal

2.15 VIBRATION SWITCH

A. Spring loaded, magnetically coupled, requiring no external power supply

B. Relay rated for output to external dry contact

C. Adjustable trip setting

D. Install switch at recommended low water level height per manufacturer recommendation
1. Acceptable Manufacturers:
   a. Marley
   b. Approved equal

2.14 ZONE PRESENSE SENSOR

A. Frequency 24.125 GHz ± 50 MHz (K-Band)

B. Detection Method

1. Initial Detection: Doppler Shift Radar

2. Selectable Additional Detection:

3. Human Presence Radar™ (HPR™)

C. Detection Pattern Selectable, wide or narrow

D. Detection Angle

1. Adjustable, 21° to 90°

2. ±25° left/right

E. Movement Direction

1. Switch selectable, unidirectional or bidirectional

F. Range Adjustable (range pot.)

G. Maximum Mounting Height 15’ (4.5m)

H. Power Requirements 12V to 24V AC or DC ± 10%

I. Power Consumption 3.5W maximum

J. Mounting

1. Flush Mounted Optional

2. Universal Mounting

K. Temperature -22°F to 158°F (-30°C to 70°C)

L. Color Flat black

M. Weight <1 lb. (0.45kg)

N. Size- 6 1/2”(w) x 1 7/8”(h) x 2 3/4”(d)

O. Install sensor at recommended height per manufacturer recommendation
1. Acceptable Manufacturers:
a. Triatek
b. Hotron
c. Approved equal

1.2 NAMEPLATES

A. Provide engraved phenolic or micarta nameplates for all 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.

1.3 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 2 - EXECUTION

2.1 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.

2.2 INSTALLATION OF CONTROL SYSTEMS

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.

O. Wiring:

1. Install control wiring and electrical work in accordance with National Electrical codes. In addition to the requirements specified herein, the wiring installation shall meet the requirements of EIA/TIA Standard 568, Commercial Building Standard for telecommunication pathways and spaces.

2. Wiring Inside Rigid Conduit: Within walls, in exposed areas, and areas exposed to weather. Minimum conduit size 3/4".

3. Plenum Rated Wiring: Concealed areas above ceilings. Coordinate with electrical contractor. Support final connection wiring in accordance to National Electric Code and at every four feet. Diagonal installation shall not be accepted. Provide sleeves for wall penetrations.

P. Water Level Switch

1. Coordinate recommended low level alarm height and recommended mounting with cooling tower manufacturer.

2. Do not alter cooling tower without express consent of owner. Work shall not alter or void any warranty.

END OF SECTION 25 11 00

SECTION 25 14 00

IAS NETWORK CONTROLLERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section defines the Basic Materials and Methods used in the installation of the Integrated Automation System (IAS).

B. 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
4. Section 251500 – IAS Software and Programming Tools for HVAC

1.2 SUMMARY

A. Section includes:
1. Java Application Control Engine (JACE).
2. BACnet IP Enabled Field Level Controller (B-BC)
3. BACnet Application Specific Controller (B-ASC).
4. BACnet Advance Application Controller (B-AAC).
5. Intelligent Sensors and Actuators (ISA).

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 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

a. Alarm monitoring and routing (locally and to Web Server)
4. Time synchronization
5. Integration of BACnet®IP (client), BACnet® MSTP, Siemens P1 and P2, Modbus®, OPC controller data, and others as required.
6. Connectivity for Network Management and programming functions for all BACnet and Siemens Apogee based devices.
7. Energy management functions
8. Control functions

1.3 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:
         a) Computer Name
         b) Object Name
         c) 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.
         d) 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, 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.

a. Schematic flow diagrams showing the systems for fans, pumps, coils, dampers, valves, and control devices. Indicate the existing point names on the schematic diagrams.
b. Wiring diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring. Indicate LAN/ BACnet and Gateway connections.
c. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
d. A floor plan indicating the actual location of room temperature sensors, carbon dioxide sensors, and occupancy sensors for coordination with furniture layout.
e. A floor plan indicating location of concealed duct static pressure sensors used for controlling air moving equipment.
f. 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.
g. 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.

B. 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

C. Closeout Submittals
   1. As-Built DDC Shop Drawings:
   2. 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.
   3. Provide record copies of product data and control Shop Drawings updated to reflect the final installed condition.
   4. Provide as-built network architecture. Drawings showing all nodes including a description field with specific controller identification, description and location information.
   5. 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.
   6. Provide record riser diagram showing the location of all controllers.
   7. Maintain Project record documents throughout the Warranty Period and submit final documents at the end of the Warranty Period.

1.2 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.

1.3 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

2.1 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.

2.2 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 unless otherwise specified. 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.

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~~ do not meet the requirement, the following must take place at the Contractor's discretion.

D. 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.

E. 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.

F. The following configurations are considered unacceptable with reference to a controller's standalone functionality:

G. 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).

H. Multiple controllers enclosed in the same control panel connected via communication wiring to accomplish the point requirement.

2.3 JACE NETWORK CONTROLLERS (NC)

A. Acceptable Manufacturers- Subject to compliance with requirements, approved manufacturers are as follows:
   1. The Distech EC-BOS line of Niagara 4 JACE 8000 is listed as a sole-source product in the District's design and construction standards. Alternate products will not be considered.

B. 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

C. The network controller must be capable of operation over a temperature range of -20ºC to 60°C.

D. 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.

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. 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.

G. The total device count allowed on each Niagara JACE 8000 series network controller is as follows:
1. Niagara N4 8005 Level Device: Do Not Use
2. Niagara N4 8010 Level Device: 8 Devices
3. Niagara N4 8025 Level Device: 20 Devices
4. Niagara N4 8100 Level Device: 62 Devices
5. Niagara N4 8200 Level Device: 62 Devices

H. 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.

I. The JACE shall utilize I/O Expansion Modules (IO-16, 10-34, IO-16-485) for direct control of equipment.

J. JACEs shall utilize the Niagara 4 Framework for discovery, installation, setup, configuration and commissioning of user defined BACnet and non-BACnet devices.

K. 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.

L. 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.

M. The JACE controller shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

N. Event Alarm Notification and Actions
1. The JACE controller shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The JACE controller shall route any alarm condition to any defined user location whether connected to a local, remote or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
   a. To alarm
   b. Return to normal
   c. To fault
4. 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.
5. Provide routing of alarms by class, object, group, or node and time.
6. 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.

7. Escalation of unacknowledged alarms to other recipients for up to three levels.
8. Control equipment and network failures shall be treated as alarms and annunciated.
9. 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:
   d. Day of week
   e. Time of day
   f. Recipient
   g. Mobile devices using SMS.
   h. Printed message, routed directly to a dedicated alarm printer.
10. 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
11. Alarm actions may be initiated by user defined programmable objects created for that purpose.
12. 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.
13. 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.
14. 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.
15. Users with sufficient password levels shall be authorized to acknowledge alarms, enter notes, etc., individually from the browser based operator workstations.
16. Alarms generated by the JACE controllers shall be presented to appropriate workstations in a manner consistent with the presentation of other alarms.
   a. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
   b. 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.
   c. Provide a “query” feature to allow review of specific alarms by user defined parameters.
   d. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
   e. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

O. Data Collection and Storage:
1. The JACE controller shall collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the JACE controller that shall have, at a minimum, the following configurable properties:
3. Designating the log as interval or deviation.
4. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
5. 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.
6. 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.

7. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
8. 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.
9. All log data, when accessed from a server, shall be manipulated using standard SQL statements.
10. All log data shall be available to the user in the following data formats:
    a. HTML
    b. XML
    c. Plain text
    d. Comma or tab separated values
11. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
12. 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:
13. Archive each JACE to the Niagara 4 server daily at a specified time of day. Stagger JACE archive times to reduce network traffic.
14. Provide ability to clear logs once archived

P. Audit Log

1. 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:
    a. Time and date
    b. User ID
    c. Change or activity (change set point, add or delete objects, commands, etc.)
    d. Database Backup and Storage
2. 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.
3. 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.
4. 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.
5. Provisioning - Automatic downloading of software updates, backups to the entire system database etc. based on user defined parameters.

Q. Network History Policies

1. 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.

R. JACE Controller and Server Licensing Requirements

1. 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.

2. Provide the Owner all required user names and passwords for system access yielding full administration and configuration rights. These shall apply to work stations, servers, network controllers, configurable network electronics, controllers, system software / database and the like.
3. 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.
4. The Contractor shall coordinate and hold no exclusive rights pertaining to inter-station links between Network Controllers.
5. The owner shall have rights to update and modify site specific graphics, application programs and database files associated with the sequence of operation.
6. 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 of 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®.
7. 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:
   a. JACE Controllers
   b. DDC Controllers

2.4 JACE 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-IO-16-485)

C. Extend control up to 4000 feet from the NC

D. Power: 12-15 Vdc

E. UL 916, CE listed, RoHS compliant

F. Industry standard RS-485 multi-drop communication bus

G. Up to 16 J-T-IO-16-485 devices can be connected to a single JACE providing a total of 256 I/O points

H. 16 max per JACE-6E or JACE-7 series controller

I. Environment
   1. Operating temperature range: 0°C to 50°C (32°F to 122°F)
   2. Storage Temperature range: 0°C to 60°C (32°F to 158°F)
   3. Relative humidity range: 5% to 95%, non-condensing

J. Universal Inputs shall be:
   1. Type III 10K ohm Thermistors
   2. Resistance 0-100 K ohms
   3. 0-10 Vdc
   4. 0-20 mA with the use of a 499 ohm resistor

K. Relay Outputs shall be:
   1. Form A contacts, 24 Vac @ 0.5 Amp

L. Analog Outputs shall be:
   1. 0-10 Vdc

M. 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).

N. Environment
   1. Operating temperature range: 0°C to 50°C (32°F to 122°F)
   2. Storage Temperature range: 0°C to 60°C (32°F to 158°F)
   3. Relative humidity range: 5% to 95%, non-condensing

O. Power: 24 Vac/dc

P. Universal Inputs shall be:
   1. Type III 10K ohm Thermistors
   2. Resistance 0-100 K ohms
   3. 0-10 Vdc
   4. 0-20 mA with the use of a 499 ohm resistor

Q. Binary Inputs minimum dwell time > 500 ms (Pulse counter range 20 Hz, 50% duty cycle)

R. Analog Outputs shall be:
   1. 0-10 Vdc each
   2. AO can supply at least 4mA over the entire 0-10 Vdc range

S. Digital Outputs shall be:
   1. Capable of switching loads up to .5A, 24 VAC
   2. Each output includes a MOV (metal oxide varistor) suppressor to support inductive type loads

2.5 BACNET IP ENABLED FIELD LEVEL CONTROLLER (B-BC)

A. Acceptable Manufacturers- Subject to compliance with requirements, approved manufacturers are as follows:
   1. The Distech Eclypse ECY line of BACnet IP controller series is listed as a sole source product in the District's design and construction standards. Alternate products will not be considered.

B. The controller shall be BTL certified as a BACnet Building Controller (B-BC), supporting all associated BACnet Interoperability Building Blocks (BIBB's).

C. BACnet/IP enabled controllers shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Variable Air Volume (VAV) Terminals and other applications as shown on the drawings.

D. The controller shall be 32 bit microprocessor-based operating at a minimum of 600 MHz.

E. They shall be multi-tasking, real-time digital control processor based supporting a fixed I/O point count.

F. Performance
   1. Each controller shall have a 32-bit microprocessor and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135 and the BACnet Device Profile supported.

G. All controllers shall be able to communicate peer-to-peer without the need for a separate network manager.
   1. Any controller on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

H. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.
   1. Shall be fully programmable and the programming software shall have a library of pre-built, tested, and user re-definable control sequences for a wide range of typical HVAC applications.
   2. All control sequences programmed into the controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Controllers shall be fully programmable.

I. BACnet Controllers shall communicate via a BACnet/IP connection at a baud rate of not less than 100 Mbps.

J. BACnet field level controllers shall have a communications port for connecting a matching room temperature and/or humidity sensor and does not utilize any of the I/O points of the Controller.

K. The Contractor supplying the BACnet Controllers shall provide documentation for each device, with the following information at a minimum:
   1. BACnet Device; MAC address, name, type and instance number.
   2. BACnet Objects; name, type and instance number

L. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each BACnet controller, as required by the drawings and specifications.

M. Each controller shall have minimum of 512MB memory, with a minimum of 4 GB non-volatile flash, to support its own operating system and databases, including: .
   1. Control processes
   2. Maintenance support applications
   3. Custom processes
   4. Energy management applications
   5. Alarm management applications
   6. Historical/trend data for points specified
   7. Embedded Web Server for local hosting of graphics.

N. Power Requirements.
   1. 24 VAC with local transformer power.

O. The controller will support the following communications protocols: .
   1. BACnet/IP.
      c. Supporting IPv4 addressing.
      d. DHCP support and Auto DNS.
      e. 2 - RJ45 ports each capable of supporting 10/100 Base-T.
         1) Supporting controller daisy-chain topology on the wired IP network via integrated switch functionality.
         2) Integrated fail-safe should allow for communication when the controller is powered down.

P. If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.

Q. The controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 20 to 28 VAC (±15%), allowing for power source fluctuations and voltage drops.

R. The controllers shall also function normally under ambient conditions of 41 ˚F to 104 ˚F and 0% to 90% RH (non-condensing).

S. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.

2.6 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.

F. 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:
3. Normally open contacts (24V and 120V).
4. Normally closed contacts (24V and 120V).
5. Current/no current.
6. Voltage/no voltage.
7. 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.

2.7 BACNET COMMUNICATING THERMOSTAT

A. Manufacturer: Subject to compliance with requirements, installing company qualifications, and manufacturer's qualifications, provide products by the following. The manufacturer shall provide DDC control hardware and software with BACnet conformance approvals from the BACnet Test Laboratory.
1. Communicating Thermostats:
   a. Distech Allure Communicating Thermostat RT Series
   b. Approved Equal

B. General Requirements:
1. The low-voltage unit thermostat shall be capable of single stage heating and cooling

or multistage 2 heating / 2 cooling and shall be programmable. The thermostat shall be have BACnet MS_TP communication capabilities.

2. Thermostat shall communicate with up to 10 zigbee Pro wall or ceiling mounted occupancy sensors, and provide stand by mode setpoint incorporating multiple wireless sensors.
3. Thermostat shall achieve accurate temperature control using a PI proportional-integral algorithm.
4. Thermostat shall be capable of local or remote override during unoccupied mode. The thermostat shall resume occupied setpoints and will revert back to unoccupied setpoints after a certain amount of time (adjustable from 0 – 24hours in one hour increments).
5. Thermostat shall have configurable temporary or permanent local override setpoints. When the “temporary setpoints” mode is enabled, once the temporary occupancy timer expires, the setpoints will revert back to their default values.
6. Thermostat shall have an adjustable “Unoccupied timer” integrated to change the occupancy mode from “Occupied” to “Standby” if no motion is detected.

C. BACnet Requirements

1. 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.
2. 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.
3. Each ASC shall perform all intended control functions in a ‘standalone’ mode should the unit incur a loss of communications.
4. 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.
5. 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.
6. 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.
7. 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.
8. Network and controller-to-controller communications must conform to BACnet® standards.
9. The following general modes of control shall be incorporated into each ASC. The sequence of operations shown in Section 25 95 00 and on the IAS Drawings indicate the final control sequence and shall define the various modes of operation:
    a. 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.
    b. 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.
    c. 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.
    d. 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.

2.8 PORTABLE WORKSTATION

A. Field Level Controllers requiring software for programming or commissioning which does not exist on the campus at the time of installation shall be provided a portable workstation including all necessary software for programming, commissioning, and troubleshooting device. 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.

2.9 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.
5. 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.
6. Sheet metals screws shall not penetrate the cabinet walls, door, or back.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 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.
3. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.
4. Application Category 0 (Distributed Monitoring):
5. Applications in this category include the following:
6. Monitoring of variables that are not used in a control loop, sequence logic, or safety.
7. Points on JACEs, AACs, and ASCs may be used in these applications as well as IASs and/or general-purpose I/O modules.
8. 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.

B. Standalone Capability:
1. Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control.
2. 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 25 14 00

SECTION 25 15 00

IAS SOFTWARE AND PROGRAMMING TOOLS

PART 1 GENERAL

1.1 RELATED SPECIFICATIONS:

A. Section 250600 - Network Scheduling Software for HVAC

B. Section 250800 – Fault Detection and Diagnostics Software for HVAC

C. Section 250900 – Chiller Plant Optimization Software

D. Section 250000 – Integrated Automation Systems (IAS) For HVAC

E. Section 251400 – IAS Network Controllers for HVAC

F. Guideline A - IAS Graphics Requirements

G. Guideline B - IAS Point Naming and Tagging Convention

1.2 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.

1.3 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. 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.
2. The graphics submittal is due within 90 days of the award of contract.
3. Include a minimum of 120 additional hours and four Owner meetings to revise graphics based on Owner and design team comments.
4. 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:

POINT NAME	HARDWARE POINTS				SOFTWARE POINTS			TREND FREQUENCY (MIN)	SHOW ON GRAPHIC (Y/N)	COMMENTS
	AI	AO	DI	DO	AV	DV	SCHED			

5. Point Summary Report: 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. 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.

3. Alarm Reports: Provide a list of all alarms, alarm limits, delays, priorities, and programmed actions associated with alarms.

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

1.4 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.

1.5 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.

1.6 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.

1.7 GRAPHICAL USER INTERFACE

A. Acceptable Manufacturers - Subject to compliance with requirements, approved manufacturers are as follows:
   1. Acuity Brands DGLux5 graphical user interface software is listed as a sole source product in the District's design and construction standards. Alternate products will not be considered.

B. The Graphical User Interface on the MiraCosta network shall be provided in whole through DGLogik's DGLux 5 visualization software (aka Atrius IoT Solutions 1 aka Envysion). 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:
   f. Create, delete or modify control strategies while the Network Controller is online.
   g. Add/delete objects and network variables to the system.
   h. Tune control loops through the adjustment of control loop parameters.
   i. Enable, disable or create control strategies; configure and program controllers.
   j. Generate hard copy records or control strategies on a printer.
   k. Select points to be alarmable and define the alarm state.
   l. Select points to be trended over a period of time and initiate the recording of values automatically.

C. 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:
         1) 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.
         2) 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.
         3) View logs and charts.
         4) View and acknowledge alarms.
         5) 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.

D. 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

2.1 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.

2.2 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.

2.3 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.

2.4 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:
   1. On call notification services and reporting
   2. Programmable Floating alarm limits
   3. Emailing of alarms including alarm escalation
   4. SMS, line printer, station recipient
   5. Alarm acknowledgement via email, SMS and remote alarm portal
   6. Alarm history acknowledgement with history and user notations.
   7. 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 acknowledger, 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:
   1. TCP/IP network management
   2. License management
   3. Serial port configuration and management
   4. Certificate management for SSL/ TLS certificates and shall include key store, trust store and lowed ost 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).
3. Single-Pole Double-Throw relay.
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.

2.5 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

2.6 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.

2.7 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.

2.8 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.

2.9 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
9. Steam Energy: Btu of steam flow
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

I. 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.

J. 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.

K. 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.
      e. The operator shall be able to modify any parameter on an individual basis at any time
   2. 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.
   3. 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.
   4. Loads shall be able to be locked out from or restored to the duty cycler by the operator at any time
   5. 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.

L. 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, 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.

M. 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.

N. 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.

O. 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:

Date	Time
Type of Alarm (HIHI, LOLO, etc.)	Value of Variable in Alarm
Operator Name	Alarm Priority
Alarm Group Name	Comment

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
1. All points included in the typical equipment point list must be represented in a common, open or accessible format.
2. Data from the IAS shall be stored in a relational database format. The format and the naming convention used for storing the database files shall remain consistent across the database and across time. The relational structure shall allow for storage of any additional data points, which are added to the IAS in future. The metadata/schema or formal descriptions of the tables, columns, domains, and constraints shall be provided for each database.
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 serverand 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:
1. 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

   j. Rate of Change Normal State
   k. 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

3.1 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

3.2 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.

D. All application programming shall be performed on-site at the district's Oceanside campus. Remote access for application programming shall not be provided.

3.3 PASSWORD SETUP

A. Follow District Standard password setup schemes.

3.4 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

3.5 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.

3.6 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.

3.7 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:
   b. Alarm @ (+) 15 percent from set point (60 percent) for 5 minutes at Priority 3
   c. Alarm @ (-) 20 percent from set point (60 percent) for 5 minutes at Priority 3
   d. Normal @ 5 percent from offset alarm parameters for 5 minutes
   e. 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.

3.8 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 wavers 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 25 15 00

SECTION 25 95 00

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. CW: Condenser Water

G. HHW: Heating Hot Water

1.4 SUBMITTALS

A. Sequence of Operations
   1. Provide a final sequence of operations based on the design intent described herein. Sequences shall include all software interlocks, alarms, safeties, and delays.

1.5 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. 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.
   5. 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.

C. Alarm conditions shall be as follows:
   1. Fans and Pumps
      a. Status point not matching it’s on/off point for 3 seconds after a time delay of 15 seconds when device is commanded on
   2. 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 it’s leaving water temperature remains 15°F below setpoint for 15 minutes
   3. Upon identification of a fault condition:
   4. For pumps:
      a. The next commanded OFF device in the staging order, Device “B”, shall be commanded ON while alarming Device “A” remains commanded ON.
      b. 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.
      c. 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).
      d. 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.
         1) 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.

1.6 WATER SOURCE HEAT PUMP (WSHP) UNIT CONTROL

A. Scheduling: The water source heat pump system will be enabled based on a time-of-day (TOD) schedule and system demand as indicated by zone thermostat or as programmed by the building operator. System operation shall be allowed at all times.

B. 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.

1. Occupied Mode: During Occupied Mode, enable operation of heat pump units and the condenser water plant and open the WSHP isolation valve. The reversing valve and DX compressors shall be staged as required to maintain the space temperature heating and cooling setpoints (adj.). The supply fan shall run continuously.
2. Unoccupied Mode: During Unoccupied Mode, disable operation of heat pump units and the condenser water plant and close the WSHP isolation valve. The WSHP shall cycle on to maintain the unoccupied space temperature setback heating and cooling setpoints (adj.). When a wall sensor override button is depressed during unoccupied period, operate the system in occupied mode for one hour (adj.). The supply fan serving the bio prep space (WSHP 1) shall operate at low speed to meet the exhaust air requirement during unoccupied team.
3. 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 water loop pumps, the boilers, and the boiler pumps. Once water loop is proved, enable the heat pump unit(s), as required, to operate in heating mode. Disable fluid coolers during warm-up mode. Terminate warm-up mode when the average zone temperature rises above the Warm-up Mode Low Temperature Setpoint.
4. 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. DX Cycle Control: Incorporate compressor minimum on time, compressor minimum off time, and compressor on/off delays for periods recommended by the WSHP manufacturer.

D. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):

1. System graphic(s) – provide one graphic for each WSHP.
   a. WSHP mode.
   b. 25Live Occupancy Command
   c. Reversing valve position.
   d. WSHP fan command
   e. WSHP fan status.
   f. Mixed air temperature
   g. Supply air temperature.
   h. Room temperature and setpoints.
   i. Occupancy sensor status (where provided)

j. All alarms.

1.7 CONDENSER WATER PLANT CONTROL

A. The condenser water system will be enabled based on a time-of-day (TOD) schedule and system demand as indicated by zone thermostat or as programmed by the building operator. System operation shall be allowed at all times.

B. Condenser Water Pump Control: When the condenser water loop is enabled, the DDC system shall start the lead condenser water pump.
1. The condenser water pump shall ramp up to the pump speed determined during TAB. The pump speed setpoint shall be that which is determined during TAB to achieve the design flow.
2. A failure of the lead CW pump shall cause the lag pump to start and an alarm condition shall be indicated at the building operator's terminal.
3. The CW pumps shall rotate lead/lag status on a monthly basis, or as programmed by the building operator.
4. If the CW flow switch signal does not match CW pump command, generate an alarm at the operator workstation.

C. Condenser Water Cooling Control: The condenser water system operates using the manufacturer provided controller. The controllers shall be integrated into the building management system.
1. When the condenser water loop is enabled, the IAS system shall enable the fluid cooler through a hardwired control point. The fluid cooler shall remain enabled with the condenser water loop.
2. The IAS system shall set the condenser water cooling setpoint through it's BACnet point "Fluid Temp Setpoint." The setpoint shall initially be set to 80 F.
3. The IAS system shall command the preconfigured operating mode of the fluid cooler during operation through it's BACnet point "Operation Mode." The operation mode shall initially be set to "Energy Saver."
4. Manufacturer's description of "Energy Saver" mode: "During periods when ambient temperatures or load form the building or process are relatively high, the Nexus Modular Hybrid Cooler operates with all spray system active across all modules. During off-design conditions, The EC Fan System will automatically and intelligently reduce speed whenever possible. As the load is satisfied, the fans and spray pumps will cycle off. When demand increases and calls for heat rejection, each module turns on in sequence. Once all modules are turned on, all fans operate at a synchronized speed."
5. If the water loop temperature exceeds a CW high limit of 100° F, generate an alarm at the operator workstation and reset all active control loops.

D. Condenser Water Heating Control:
1. If the condenser water drops 5° F (adj.) below the condenser water heating setpoint (67°F adj) for a period of 15 minutes (adj.) enable the boiler.
2. Upon proof of pump operation as indicated by the current sensing relay and sufficient CW flow as indicated by the boiler's flow switch, enable the boiler's controller for operation.
3. The boiler shall operate under its own internal controls to maintain the condenser water heating setpoint. This set point shall be set by the building operator via the DDC system.
4. If the condenser water temperature rises 5° F (adj.) above the condenser water heating setpoint for a period of 15 minutes (adj.), disable the boiler's controller.
5. Appropriate time delays shall be utilized between each step per the boiler

manufacturer's recommended time intervals.

6. If the water loop temperature exceeds a CW low limit of 58° F, generate an alarm at the operator workstation and reset all active control loops.

E. Safeties:
1. Disable the fluid cooler's pump if the water level in the fluid cooler's basin falls below its minimum allowable level. Initiate a Low Water Basin Alarm at the BAS operator workstation.
2. Disable the fluid cooler upon a signal from the vibration switch.
3. Disable the condenser water system and generate an alarm at the BAS operator workstation if the CW pump status is on and the cooling tower flow switch indicates no flow for a period of 3 minutes.

F. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):
1. System graphic(s) – provide one graphic for condenser water system overview.
   a. Outside air dry bulb temperature
   b. Outside air wet bulb temperature
   c. Outside air dew point (Calculated)
   d. Condenser water supply heating/cooling temperature setpoints
   e. Condenser water supply temperature
   f. Condenser water return temperature
   g. CW pump speed
   h. Boiler BACnet LAN points (display in a pop-up window)
      1) Boiler state (multistate value – program and display manufacturer descriptions associated with the boiler multistate value)
      2) Boiler status (multistate value – program and display manufacturer descriptions associated with the boiler multistate value)
      3) Boiler error code (multistate value – program and display manufacturer descriptions associated with the boiler multistate value)
      4) Firing rate (read)
      5) Supply temperature (read)
      6) Return temperature (read)
      7) Boiler mode (read/write)
      8) CH Setpoint (read/write)
      9) Reset Curve Boiler Maximum (read/write)
      10) Reset Curve Boiler Maximum (read/write)
      11) Burner enable (read/write)
      12) Boiler run time
   i. VFD LAN points for each VFD (provide in a pop-up window)
      1) VFD run status
      2) Fault status
      3) Bypass status
      4) Frequency (Hz)
      5) RPM
      6) Current (amps)
      7) Power (kW)
      8) DC bus voltage
      9) Output voltage
      10) VFD temperature
      11) Run time (hours and thousands of hours)
   j. All Alarms.
2. Fluid Cooler BACnet points to display in the main CW system graphic
   a. Operating Mode (read/write)
   b. Fluid Temperature Setpoint (read/write)
   c. Unit Status (read)
   d. Pump Status (read)

e. Pump Fault (read)
f. Leaving water temperature high message (read)
g. Leaving water temperature low message (read)
h. Water high level message (read)
i. Water low level message (read)
j. Alarm Reset (read/write)
k. VFD run status
l. Conductivity Sensor (read)
m. Fan Speed (read)
n. Fan Status (read)
o. Common Alarm Fan (read)
p. Modules Operating (wet) (read)
q. Modules Operating (dry) (read)
r. Conductivity Setpoint (read/write)
s. Conductivity Differential Setpoint (read/write)
t. Water Management Time Bleed Enable (read/write)
u. Water Management Time Drain Enable (read/write)
v. Alarm Reset (read/write)
w. Cold Weather Active (read)
x. Single Cell Critical Message (READ)
y. Fault status
z. Bypass status
aa. Frequency (%)
bb. Actual Speed- dry/wet (RPM)
cc. Motor Input Power- dry/wet (kW)
dd. Run time (hours and thousands of hours)
ee. Motor input voltage -r
ff. Motor input current -r
gg. All Alarms – r

1.8 BIOLOGY PREP SPACE (FUME HOOD) EXHAUST FAN – EF-1

A. Provide DDC control using electric actuation.

B. The exhaust fan shall operate based on the time of day schedule (or as programmed by the building operator.).

C. During scheduled occupied period,
   1. The fan shall operate at occupied mode speed setpoint.
   2. The occupied mode speed setpoint shall be that which is determined during the TAB to achieve the fume hood and storage cabinet exhaust requirements.

D. During scheduled unoccupied period,
   1. The fan shall operate at an occupied mode speed setpoint if the room is occupied as sensed by the zone presence sensor.
   2. The fan shall operate at an unoccupied mode speed setpoint if the zone presence sensor is in unoccupied mode for continuous 15 minutes.
   3. The unoccupied mode fan speed setpoint shall be that which is determined during the TAB to achieve the fume hood and storage cabinet exhaust requirements.

E. Safety:
   1. The DDC system shall use a current sensing relay to monitor the fan status.

F. Operator Station Display: Indicate the following on operator workstation display terminal

(minimum requirements):
1. System graphic(s).
   a. Zone Presence Sensor Status (Occupied/ Unoccupied)
   b. VFD LAN points for VFD (provide in a pop-up window)
      1) VFD run status
      2) Fault status
      3) Bypass status
      4) Frequency (Hz)
      5) RPM
      6) Current (amps)
      7) Power (kW)
      8) DC bus voltage
      9) Output voltage
      10) VFD temperature
      11) Run time (hours and thousands of hours)
   c. All Alarms.

1.9 STORAGE ROOM EXHAUST FAN- EF-2

A. Provide DDC control using electric actuation.

B. The exhaust fan shall enabled based on demand as indicated by the room temperature sensor, or as programmed by the building operator. System operation shall be allowed at all times.
   1. The exhaust fan shall be energized when the room temperature sensor indicates the space has exceeded 85°F (adj.) and shall remain energized until the space temperature falls below 78°F (adj.).
   2. The exhaust fan shall run for a minimum of 10 minutes (adj.)

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).
      a. Exhaust fan on-off indication, run status, and alarms.
      b. Storage room temperature
      c. Fan enable/disable temperature setpoints

1.10 DUCTLESS SPLIT SYSTEM CONTROL

A. The unit shall maintain the room temperature setpoint using its manufacturer supplied controller.

B. Unit controllers shall be integrated into the building management system via a BACnet gateway.

C. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):
   1. System graphic(s).
   2. Integrated Points:
      a. Enable/disable (r/w)
      b. System mode (r/w)
      c. Room temperature setpoint (r/w)

d. Room temperature (r)
e. Fault code (multistate value – program and display manufacturer descriptions associated with the multistate value)

1.11 UTILITY METERING

A. Operator Station Display: Indicate the following on operator workstation display terminal (minimum requirements):
1. Provide a dedicated utility metering GUI dashboard page for the building.
   a. Instantaneous domestic water usage (gallons per minute)
   b. Instantaneous natural gas usage (MBH)
   c. Instantaneous electrical usage (kW)
   d. Integrated electrical meter points (display on a drill down or pop up)
      1) Current per phase (amp)
      2) Power factor
      3) Reactive power (kVAR)
      4) Apparent power (kVA)
      5) Real power (kW)
2. Combined building energy consumption based on the addition of electricity and natural gas. Convert all utility consumption to BTU's.
3. Provide a stacked area graph to view the historic consumption of each utility. Provide area stacked graphs with gradient transparency. Line graphs are not acceptable.
4. Allow the user to select the historical utility usage type to view. Historic utility usage type options shall include natural gas, electrical, water, and combined energy consumption.
5. Allow the user to select the period to view. At a minimum, the choices shall include; today, yesterday, last week, last year, or a user selected time period.
6. Provide an optional line overlay to compare previous time period energy consumption to the current selection. The previous time period shall be identical to eth selected time period.
7. For the combined electrical utility, provide a stacked area graph view which shows the contribution of each electrical submeter to the whole. Refer to electrical sheets E0.1 and E6.02 for an electrical single line and panel schedule which shows the service of each submeter. Provide at a minimum the following sub metered categories.
   a. Whole building electrical meter
   b. Single panel electrical use; in the stacked graphs, deduct electrical use of subpanels from the main panel electrical use.
8. Show an energy use intensity (EUI) table which displays the following EUI's based on the most recent 12 months of complete usage history.
   a. Combined building EUI (BTU/SF-YR)
   b. Electrical use index (kWh/SF-YR)
   c. Natural gas use index (BTU/SF-YR)
   d. Water use index (Gal/SF-YR)

1.12 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.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 25 95 00

SECTION 26 00 00

GENERAL ELECTRICAL REQUIREMENTS

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.

1.02 SCOPE

A. Basic electrical requirements specifically applicable to Division 26 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 provide complete and operational electrical systems including:

   a. All temporary construction power including test power, temporary heat and lighting;
   b. Incidental items not indicated on the drawings nor mentioned in the Specifications that belong to the work described, or are required to provide complete and operable systems, as though called out here in every detail;
   c. Cleaning, cutting, patching, repairing and painting;
   d. Testing and commissioning;
   e. The Contractor shall coordinate this Section with all other Sections of the Specification.

1.03 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 workmanlike 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. In the event of a conflict or inconsistency between items indicated on the plans and/or specifications or with code requirements, the note, specification or code which prescribes and establishes the more complete job, or the higher standard prevail.

D. 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.

E. For purposes of clearness and legibility, the electrical drawings are essentially diagrammatic. The size and location of equipment is shown to scale where possible. The contractor shall verify all conditions, data information as indicated on the drawings and in the specification sections where electrical work interfaces with other trades.

F. Contract Documents are intended to show the scope and general arrangement of the Work under this Contract. 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.

G. The contractor shall maintain as built drawings to reflect all changes made during construction and any deviations from the electrical drawings. This includes deviations from circuit numbers and any addition, deletion or relocation of fixtures/outlets shown on working drawings.

1.04 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.

1.05 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, Chapter 4. Division of Industrial Safety, Subchapter 5. Electrical Safety Orders (Cal/OSHA):

    a. Low-Voltage Electrical Safety Orders (Sections 2299 - 2599)
    b. High-Voltage Electrical Safety Orders (Sections 2700 - 2989)

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. ANSI American National Standards Institute
2. IEEE Institute of Electrical and Electronic Engineers
3. NEMA National Electrical Manufacturer’s Association
4. NFPA National Fire Protection Association Standards
5. 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. Nothing in these drawings and specifications shall be construed to permit work not conforming to governing codes or regulations. 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.

1.06 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 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.

1.07 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, conduits, 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.

1.08 DISCREPANCIES

A. The contractor shall check all drawings furnished to him immediately upon their receipt and shall promptly notify the owner of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings in general govern small scale drawings. The contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby. Where no figures or notations are given, the plans shall be followed

B. Omissions from the Drawings or Specifications or the erroneous description of details of work which are manifestly necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or erroneously described details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

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.

1.09 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.

1.10 SUBMITTALS

A. Refer to Division 01 for additional requirements.

B. 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.

C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.

D. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Owner's Representative.

F. Submit all Division 26 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.

G. 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 UL, 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.

H. The Contractor shall submit all passcodes and passwords for any hardware and software required for the operations and troubleshooting in all systems and components no less than fourteen (14) calendar days prior to Final Completion.

1.11 PROJECT RECORD DOCUMENTS

A. Refer to Division 01 for additional requirements.

1. All changes, deviations and information recorded on the "Project Record Drawings" set during Construction shall be redrafted using the latest version of AutoCAD or Revit, where applicable.
2. Submit completed shop drawings to the Owner prior to completion in digital format.
3. Contractor hand-marked or drafted redlined "Project Record Drawings" will not be accepted.

1.12 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

A. Refer to General Conditions and Division 01 for additional requirements.

1.13 OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.14 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.

1.15 DELIVERY AND STORAGE

A. Refer to Division 01 for additional requirements.

B. 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.

1.16 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.

PART 2 - PRODUCTS

2.01 COMPETITIVE PRODUCTS

A. Unless otherwise noted, any reference in the Specification to any article, device, product, material, fixture, form, or type of construction by name, make, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may at his option propose substitutions for such material in accordance with the substitution procedure outlined in the Contract Documents.

B. Equipment specified in the following SECTIONS shall all be provided by the same manufacturer.

1. 262416 Panelboards

2.02 MATERIALS

A. Provide all new materials and equipment, free from any defects, in first-class condition, and suitable for the space provided. Provide materials and equipment approved by UL authority having jurisdiction approved testing agency, wherever standards have been established by that agency.

B. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of units or equipment need not be products of the same manufacturer.

C. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

D. Provide materials and equipment with manufacturers' standard finish system, except where otherwise specified. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with ANSI Number 61, light gray color.

E. Environmental and Seismic Conditions: Material and Equipment shall be designed to insure satisfactory operation and operational life in the environmental and seismic conditions which will prevail where they are being installed. Electrical equipment and enclosures shall be designed, constructed and certified to withstand external loading conditions as prescribed by the California Building Code for the locations of the equipment. Supplied equipment shall either be shake table tested and certified or comprehensive seismic calculations shall be provided. All seismic calculations and structural drawings shall bear the seal of a Structural Professional Engineer currently licensed in the State of California. Earthquake design shall be based on the equivalent lateral force analysis procedure (ASCE 7-05 Section 12.8) with the following factors:

1. Location: 33.74765 LAT, -118.19099 LONG
   Site Class E
   S_S = 1.592 g, S_1 = 0.600 g,
   S_{MS} = 1.433 g, S_{M1} = 1.440 g,
   S_{DS} = 0.955 g, S_{D1} = 0.960 g
2. R = 2 (Enclosure Attachment)
   R = 1.5 (Transformer Attachment)
3. CS = 0.51
4. SDC = D
5. V = 52 k (Enclosure and Electrical Equipment)

PART 3 - EXECUTION

3.01 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.

3.02 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 construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the conduit runs, 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. The electrical drawings do not indicate all fittings, hardware, or appurtenances required for a complete operating installation.

I. Wiring diagrams are not intended to indicate the exact course of raceways.

J. One-line and riser diagrams are only schematics and do not show physical arrangements of equipment.

K. All workmanship, including aesthetic as well as electrical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.

L. Replace or repair, without additional compensation, any Work, which, in the opinion of the Owner, does not comply with these requirements.

3.03 CLEANING & PAINTING OF EQUIPMENT

A. Refer to Division 09 for additional requirements.

B. Factory Applied:

1. Electrical 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: Paint electrical equipment as required to touch up, to match finish on other equipment in adjacent spaces, or to meet safety criteria.

D. After installation, all metal finishes shall be polished and cleaned of all dirt, rust, cement, plaster, grease, and paint.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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.

1.02 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260533 “Raceways and Boxes for Electrical Systems"
2. Section 271000 "Communications Horizontal Cabling" for cabling used for voice and data circuits.
3. Section 260553 "Identification for Electrical Systems."

1.03 DEFINITIONS

A. ASTM: American Society of Testing Materials.

B. ICEA: Insulated Cable Engineers Association.

C. IEEE: Institute of Electrical & Electronics Engineers.

D. NEMA: National Electrical Manufacturers Association.

E. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.

F. VFD: Variable frequency drive.

1.04 ACTION SUBMITTALS

A. Product Data: Submit manufacturer’s technical data for each type of product, indicating conductor/cable construction, insulation material, thickness of insulation, jacket, cable stranding, and voltage rating of each type of conductor/cable specified, splices and terminations. Indicate date and place of manufacture for each conductor/cable, cable, splice and termination.

B. Manufacturer’s ISO certification.

C. Product Cable Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Independent Testing Agency.

B. Field quality-control reports. Perform field testing of cables per para 3.8. Submit six (6) copies of field test reports to owner's representative within two (2) weeks of completion of test.

1.06 QUALITY ASSURANCE

A. General Requirements: The low voltage power conductors and cable shall be copper, minimum 600V rated unless otherwise indicated. Aluminum conductors and cables shall not be accepted unless otherwise indicated.

B. Materials and installation shall meet or exceed requirements in the following referenced standards and shall be listed and labelled by UL.

1. ICEA S-95-658/ NEMA WC 70.
2. UL 1072.
3. IEEE.
4. ASTM.
5. NEMA.

C. Conductors and cables shall be of the same manufacturer and shipped to the job site in original unbroken reels.

D. Conductors and cables shall be manufactured with in twelve (12) months of installation. Date of manufacture shall be clearly marked on conductors or conductor reels.

E. Manufacturer shall have minimum ten (10) years experience in the manufacturer of conductors and cables similar to those specified on this project.

F. Manufacturer shall have ISO 9001 and ISO 9002 certification.

G. All conductors and cables shall be new and supplied by a local distributor.

H. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the owner/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the owner/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the owner/engineer and all tests shall be witnessed by owner's/engineer's personnel. All testing procedures and test results shall be satisfactory to the owner/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one owner's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

I. Testing: Provide the services of an independent qualified testing laboratory to perform the specified field tests. Notify the University's Representative fourteen (14) days in advance of performance of work requiring testing.

J. Conductors, cables, splices and terminations shall be manufactured within twelve (12) months of installation. Each item shall have a permanent marking on the product or the original manufacturers' package indicating the date of manufacture unless otherwise noted.

K. Testing Agency Qualifications:

1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of low voltage electrical power conductors and cables similar to those specified on this project.
2. Testing company shall be located with 50 miles radius of the project.
3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of low voltage power conductors and cables of the type and rating similar to the conductors and cables to be tested on this project.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

B. Basis-of-Design Product:

1. General Cable Technologies Corporation.
2. Southwire Incorporated
3. Alpha Wire.
4. Belden Inc.
5. Encore Wire Corporation.

C. Conductor Material: Electrical grade, soft drawn annealed copper, 98 percent conductivity, and fabricated in accordance with ASTM and ICEA standards. Minimum size is number 12 for branch circuits, number 14 stranded for control wiring. Aluminum conductors are not permitted. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2, Type XHHW-2 for all underground and wet locations.

E. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for with ground wire.

F. VFD Cable:

1. Comply with UL 1277, UL 1685, and CEC for Type TC-ER cable.
2. Type TC-ER with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

3. Comply with UL requirements for cables in Classes I and II, Division 2 hazardous location applications.

G. Provide separate neutral with each branch circuit serving outlets. When dedicated neutrals are provided, use color spiral to match associated phase.

2.02 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Ideal Industries, Inc.
2. Ilsco
3. NSi Industries LLC.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. 3M; Electrical Markets Division.
6. TE Connectivity - Raychem.
7. Spears-DS400 Dri Splice Pre-filled

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Copper conductors shall be terminated in copper or bronze mechanical connectors or lugs or tool applied compression connections made of copper for all connections except those on wiring devices.

D. Splices in wires No. 10 and smaller shall be made with twist-on splicing connector in accordance with UL486-C. Connections in wires No. 8 and larger shall be made with compression type connectors in accordance with UL486-A and wrapped with insulated tape in accordance with UL501. Insulating tape shall be applied in a minimum of two layers of half wrap or built to match the overall insulation of the wire.

E. Splices in underground pull boxes shall be made submersible type and made using “3M” Scotch-cast epoxy kits.

F. Pressure type connectors are not permitted.

2.03 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

B. Comply with CEC.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFD cable, which shall be extra flexible stranded.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway

B. Exposed Feeders: Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway

E. Feeders Installed below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway

H. Branch Circuits Installed Below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway

I. Branch Circuits in Cable Tray: TC rated Type THHN-2-THWN-2, single conductors in raceway

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. VFD Output Circuits: Type XHHW-2 in metal conduit or Type TC-ER cable with braided shield with dual tape shield.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. All conductors and cables shall be installed in a raceway.

B. Before installing conductors and cables in existing conduits, verify the continuity of each conduit; each surface conduit is properly supported per code and clear of any debris.

C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

H. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.05 IDENTIFICATION

A. Each conductor shall be factory color coded by conductor manufacturer. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Engage an independent qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance conductors, feeder conductors and the conductors feeding the following critical equipment and services for compliance with requirements; mechanical equipment.
2. Perform each visual and mechanical inspection and electrical tests stated in latest NETA Acceptance Testing Specification section 7.3.2 (Inspection and Test Procedures-Cables, Low Voltage-600V Maximum). Certify compliance with test parameters per NETA tables.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements. Include color scan images.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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.

1.02 SUMMARY

A. Section Includes: Grounding systems and equipment.

B. Section includes Grounding systems and equipment, plus the following special applications:

1. Overhead-line grounding.
2. Underground distribution grounding.

1.03 Definitions:

A. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.

B. NETA MTS: InterNational Electrical Testing Association - Maintenance Testing Specification.

C. NFPA: National Fire Protection Association.

1.04 ACTION SUBMITTALS

A. Product Data: Submit manufacturer’s technical catalog cuts for each type of product indicated.

B. Shop Drawings: Site drawings to scale including details showing location and size of each field connection of grounding system.

1. Wiring Diagrams: Differentiate between manufacturer installed and field installed wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans drawn to scale (1/4”=1’-0”) showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Grounding conductors, connectors.

B. Qualification Data: For qualified independent testing agency and testing agency's field supervisor.

C. Field quality-control reports. Submit written test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals, include the following:

1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS and NFPA 70B.

   a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
   b. Include recommended testing intervals.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of grounding systems similar to those specified on this project.
2. Testing company shall be located with 50 miles radius of the project.
3. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of rounding systems of the type and rating similar to the systems to be tested on this project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 GROUNDING ELECTRODES, CONDUCTORS, CONNECTOR, BUS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:

1. Grounding Connectors, Bars and Rods:

a. Erico Inc.; Electrical Product Group
b. Framatome Connectors/Burndy Electrical.
c. Ideal Industries, Inc.
d. O-Z/Gedney Co.; a business of the EGS Electrical Group.
e. Thomas & Betts, Electrical.

2. Grounding Conductors and cables:

a. Southwire
b. American Insulated Wire
c. Okonite

2.02 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.03 CONNECTORS

A. Listed and labeled by UL for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.

3.03 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits in the same conduit containing phase and neutral conductors. Comply with CEC, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by CEC are indicated.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by CEC:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Signal and Communication Equipment: In addition to grounding and bonding required by CEC, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
4. All metallic conduits and cable tray shall be continuously bonded to maintain low resistance ground path and bonded back to the central equipment by the use of bonding jumpers where needed.

G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode next to the pole and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors. Provide a handhole for the grounding electrode at each pole.

3.04 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade using exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install ground rods at least three rods (unless otherwise indicated on the drawings), spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Separately Derived System (SDS): All multiple branch metal water piping laterals originating from outside the area being served by the SDS and which serve the same area being served by the SDS shall be bonded to the common grounding electrode (GE) or the common grounding electrode conductor (GEC). The bonding connection shall be made at each level that the metal water piping serves. When multiple SDS's are installed or a SDS serves multiple levels of a structure, a copper common GEC shall be installed for the SDS as permitted in CEC article 250.30 (D)3 and sized per article 250.30 (A) and (B).
3. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
4. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

G. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to CEC; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.05 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage an independent qualified testing agency to perform tests and inspections. Refer to section

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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.

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Section 260548 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.
   4. Equipment supports.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with CEC.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

   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:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper B-Line, Inc.; a division of Eaton Inc.
b. ERICO International Corporation.
c. GS Metals Corp.
d. Thomas & Betts Corporation: A Member of the ABB Group.
e. Unistrut; Part of Atkore International,

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   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:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.

3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in CEC. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in CEC.

C. 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.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as 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 minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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.

1.02 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.03 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. EMT: Electrical metal tubing

C. ENT: Electrical non-metallic tubing

D. GRC: Galvanized rigid steel conduit.

E. HDPE: High density polyethylene pipe

F. IMC: Intermediate metal conduit.

G. LFMC: Liquidtite flexible metal conduit

H. LFNC: Liquidtite flexible non-metallic conduit.

I. RNC: Rigid non-metallic conduit

J. RTRC: Reinforced thermosetting resin conduit

1.04 QUALITY ASSURANCE:

A. Each conduit shall bear manufacturer's trademark and UL label.

B. Each type of conduit and fittings shall be of a single manufacturer. Multiple manufacturers of the same material are not acceptable.

C. Comply with California Electric Code (CEC)

1.05 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal 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. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

~~A.~~ Manufacturers: Subject to compliance with requirements provide products by one of the following

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Electri-Flex Company.
3. O-Z/Gedney; a brand of EGS Electrical Group.
4. Thomas & Betts Corporation.
5. Western Tube and Conduit Corporation.
6. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be UL listed and labeled as defined in CEC and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and CEC.
2. Fittings for EMT:
    a. Material: Steel
    b. Type: Compression.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in CEC, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following

1. CANTEX Inc.
2. Condux International, Inc.
3. Electri-Flex Company.
4. RACO; a Hubbell company.
5. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers 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."

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to CEC.

1. Metal wireways installed outdoors shall be listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.04 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Cooper Technologies Company; Cooper Crouse-Hinds.
2. Hoffman; a Pentair company.
3. Hubbell Incorporated; Killark Division.
4. RACO; a Hubbell Company.
5. Thomas & Betts Corporation.
6. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb. (23 kg) shall be listed and marked for the maximum allowable weight.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep.

L. Gangable boxes are prohibited.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

2.05 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in CEC, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

~~1.~~ Manufacturers: Subject to compliance with requirements provide products by one of the following

a. Jensen Precast Inc.
b. CDR Systems Corporation; Hubbell Power Systems.
c. Oldcastle Precast, Inc.; Christy Concrete Products.
d. Synertech Molded Products; a division of Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.". Boxes containing conductors and cables over 600V, the cover shall include permanently engraved name of the utility company, type of utility (e.g. ELECTRIC), DANGER-HIGH VOLTAGE-KEEP OUT” in minimum 1/2" inch size, block letters.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.06 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC
2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC. Use EPC-40PVC inside concrete walls and columns only.
3. Underground Conduit: Type EPC-40-PVC
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT
2. Exposed, Not Subject to Severe Physical Damage: EMT
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

    a. Mechanical rooms.
    b. Gymnasiums.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Concealed in concrete walls and columns: RNC Type EPC-40-PVC.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations. All FMC shall be steel.
7. Damp or Wet Locations: GRC.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in kitchens and damp or wet locations.
9. Raceways serving light fixtures shall be minimum ¾” steel flex and shall not exceed 6’.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size for all applications including controls.

D. Raceways and fittings terminating at equipment, enclosure or pullbox shall have a seal tight fitting at the end of the equipment.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10. Set-Screw fittings are prohibited from use.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

G. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

H. Install surface raceways only where indicated on Drawings.

I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with CEC limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 250lbs (113 kgs) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Provide acrylic identification tags (2”X4”) at each end indicating the source. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to CEC and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to CEC.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by CEC.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312200 "Grading" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312200 "Grading".
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312200 "Grading".
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances. Top of conduits inside the handhole/box shall be minimum 4 inches above the bottom of the handhole/box.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel (minimum 6-inch-high), graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 36

CABLE TRAYS FOR ELECTRICAL SYSTEMS

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.

1.02 SUMMARY

A. Section Includes:

1. Ladder cable trays.
2. Single-rail cable trays.
3. Trough cable trays.
4. Fiberglass cable trays.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale (1/4”=1’-0”), on which the following items are shown and coordinated with each other, using input from installers of the items involved:.

1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Certificates: For cable trays, 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.

C. Field quality-control reports. Submit within two (2) weeks of completion of tests.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

1. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
2. Component Importance Factor: 1.5.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in CEC and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.03 LADDER CABLE TRAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers

1. Chalfant Manufacturing Company.
2. Cooper B-Line, Inc.
3. Mono-Systems, Inc.

B. Description:

1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
2. Rung Spacing: 18 inches (450 mm) o.c.
3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
7. Minimum Usable Load Depth: 6 inches (150 mm).
8. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
9. Width: 18 inches (450 mm) unless otherwise indicated on Drawings.
10. Fitting Minimum Radius: 12 inches (300 mm)
11. Class Designation: Comply with NEMA VE 1, Class 12C
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316
14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.04 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.

a. Standard: Comply with ASTM A 653/A 653M, G90 (Z275).
b. Hardware: Galvanized, ASTM B 633

5. Finish: Electrogalvanized before fabrication.

   a. Standard: Comply with ASTM B 633.
   b. Hardware: Galvanized, ASTM B 633.

6. Finish: Hot-dip galvanized after fabrication.

   a. Standard: Comply with ASTM A123/A123 M, Class B2.
   b. Hardware: Stainless steel, Type 316.

7. Finish: Powder-coat enamel paint.

   a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
   b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
   c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
   d. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.

B. Stainless Steel:

1. Materials: Low-carbon, passivated, stainless steel, Type 316L, ASTM F 593 and ASTM F 594.
2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.05 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Covers: Louvered type made of same materials and with same finishes as cable tray.

C. Barrier Strips: Same materials and finishes as for cable tray.

D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.06 WARNING SIGNS

A. Lettering: 1-1/2-inch- (40-mm high, black letters on yellow background with legend "Warning! Not to Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.07 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. (90 kg). Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

O. Make changes in direction and elevation using manufacturer's recommended fittings.

P. Make cable tray connections using manufacturer's recommended fittings.

Q. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

S. Install cable trays with enough workspace to permit access for installing cables.

T. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

U. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

V. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

W. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

A. Ground cable trays according to CEC unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch (1800-mm) intervals. The grounding conductor shall be sized according to CEC, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to CEC, Article 250.122, "Size of Equipment Grounding Conductors."

3.03 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

E. Tie MI cables down every 36 inches (900 mm) where required to provide a 2-hour fire rating and every 72 inches (1800 mm) elsewhere.

F. In existing construction, remove inactive or dead cables from cable trays.

3.04 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect raceways to cable trays according to requirements in NEMA VE 2.

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by CEC. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.06 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

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.

1.02 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct bank(s)
2. Handholes and boxes.

B. Related Requirements:

1. Section 260526 “Grounding and Bonding of Electrical Systems”.

1.03 DEFINITION

A. RNC: Rigid nonmetallic conduit.

B. PVC coated GRS: PVC coated Galvanized rigid steel conduit

C. PVC: Poly Vinyl Chloride

D. NETA: InterNational Testing Association

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, boxes, and other utility structures.
4. Warning tape.
5. Warning planks.
6. Pull ropes.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder details.
5. Grounding details.
6. Cable racks, insert. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

C. Shop Drawings for Factory-Fabricated Manholes, Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design. Include details of factory engraved markings as specified.
3. Grounding details.
4. Cable racks, inserts. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.05 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified California registered professional electrical engineer.

B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858. Certificates shall be signed by manufacturer's structural engineer. Include name and date.

C. Qualification Data: For professional engineer and testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with CEC.

D. Each conduit shall bear manufacturer's trademark and UL label. Conduits and fittings shall be of a single manufacturer. Multiple manufactures for the same material are not acceptable.

E. Comply with California Electric Code (CEC).

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Deliver precast concrete handholes and other underground utility structures when the site is ready for installation. Store precast concrete and other factory-fabricated underground utility structures at project site (if necessary) as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.08 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify College no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without College Representative's written permission.
3. Existing electrical service shall be shut down by owner's authorized personnel. Coordinate with owner in advance.

1.09 COORDINATION

A. Coordinate layout and installation of ducts, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.10 EXTRA MATERIALS

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.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed (minimum six of each type).

PART 2 - PRODUCTS

2.01 CONDUIT

A. Plastic-Coated Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1. Plastic-Coated Rigid Steel Conduit and Fittings: Rigid steel conduit and fittings with an extruded polyvinyl chloride jacket, minimum 40 mils. The jacket shall have high tensile strength, shall be highly resistant to corrosion and shall not oxidize or deteriorate or shrink when exposed to sunlight and weather. The jacket shall be flame retardant and shall not support combustion. The interior of the conduit shall have a urethane coating, minimum 2 mils.

B. RNC: Heavy wall design; NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. Make all fittings watertight with solvent-weld recommended by the conduit manufacturer and specifically manufactured for the purpose.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cantex, Inc.
2. Thomas & Betts-Carlon
3. Lamson & Sessions -Carlon Division
4. JM Eagle
5. Allied Tube and Conduit

2.02 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.

    a. Color: Red dye added to concrete during batching.
    b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.03 PRECAST CONCRETE HANDHOLES AND BOXES

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products
2. Oldcastle Precast Group
3. Jensen Precast

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have traffic load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
4. Cover Legend: Molded lettering, NAME OF SERVING UTILITY COMPANY "ELECTRIC" or “GROUNDING”.
5. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
6. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

    a. Extension shall provide increased depth of 12 inches (300 mm).
    b. Slab: Same dimensions as bottom of enclosure and arranged to provide closure.

7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

    a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

9. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.04 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, NAME OF SERVING UTILITY COMPANY "ELECTRIC".
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. NewBasis.
    e. Oldcastle

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Christy Concrete Products.
    d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
    e. Newbasis

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of fiberglass.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carson Industries LLC.
    b. Christy Concrete Products.
    c. Nordic Fiberglass, Inc.

E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be polymer concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carson Industries LLC.
b. Nordic Fiberglass, Inc.
c. PenCell Plastics.

2.05 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bilco Company (The).
2. Christy Concrete Products.
3. Jensen Precast
4. Neenah Foundry Company.
5. Oldcastle Precast Group.
6. Underground Devices, Inc.
7. Utility Concrete Products, LLC.

B. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.

1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

C. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.

D. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

E. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

F. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

G. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean

surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

2.06 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 PVC, in direct-buried duct bank, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40 PVC, in direct-buried duct bank, unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40 PVC installed in duct bank, unless otherwise indicated.

F. Underground Ducts Crossing Paved Paths, Walks, and Driveways: RNC, NEMA Type EPC-40 PVC, encased in reinforced concrete.

3.02 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.

2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

3.03 EARTHWORK

A. Excavation and Backfill: Comply with Section 31 22 00 "Grading", but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 32 93 00 "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Section 01 73 29 "Cutting and Patching."

3.04 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 12.5 feet (4 m), both horizontally and vertically, at other locations, unless otherwise indicated. For underground ducts containing MV and HV cables, use manufactured long sweep bends with a minimum radius 25 feet (7.5 m) both horizontally and vertically. Number of bends on ducts for HV and MV systems, telephone and signal systems shall not exceed two (2) 90 degrees.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid PVC coated steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

F. Do not install conduits underneath a building except where the service/feeder/branch circuit conduits enter the building.

G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

H. Pulling Cord: Install minimum 1/8 inch thick test nylon cord with minimum 250 pounds per foot tensile strength in ducts, including spares.

I. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Encase all feeder ducts in a 3 inch concrete envelope. Extend envelope with 3 inches beyond all external surfaces of all outer most ducts. Do not over pour the concrete.
5. Concrete encasement shall be minimum 3000 psi. All underground ducts containing MV and HV cables (above 600V) shall be encased in red concrete. Concrete shall be premixed during batching with 1-1/2 lbs of red ocher dye per sack of cement.
6. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
7. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
8. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall and 12 inches (300 mm) between power and signal ducts.

9. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated. Minimum depth below grade in all areas shall be 36 inches (900 mm) for underground ducts containing MV and HV ducts.
10. Stub-Ups: Use manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple PVC coated steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

11. Warning Tape: Bury warning tape approximately 12 inches (300 mm) below grade above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

J. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 31 22 00 "Grading" for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in Section 31 22 00 "Grading".
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Section 31 22 00 "Grading".
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 12 inches (300 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple PVC coated steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

b. For equipment mounted on outdoor concrete bases, extend PVC coated steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

11. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.05 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches (38 to 50 mm) thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of 12 inches thick crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. In other areas, set manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below the frost line, below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Waterproofing: Apply waterproofing to exterior surfaces of handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 07 11 13 "Bituminous Dampproofing." After ducts have been connected and grouted, and before

backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.06 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of 12 inches thick crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, <Insert depth of frost line below grade at Project site> below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 03 30 00 "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.07 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.08 FIELD QUALITY CONTROL

A. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed from manhole to vault, a testing mandrel not less than 12 inches long with a diameter 1/4-inch less than the size of the duct, shall be drawn through each duct, after which a brush having the diameter of the duct, and have stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, gravel and other foreign materials. Conduit plugs shall then be immediately installed. Underground conduits, which terminate inside the building below grade, or which slope so that water might flow into building, shall be sealed at termination after installation of wires.

B. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Correct deficiencies and retest as specified above to demonstrate compliance.

3.09 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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.

1.02 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, products by one of the following manufacturers

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers

a. Pre-sealed Systems.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. 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."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.

G. Underground, Exterior-Wall and Floor Penetrations: Install PVC Coated cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 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. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. All general conditions and supplementary general conditions apply to the work of this section. Provide and perform the vibration isolation work as indicated, specified, and required.

B. Principal work included in this Section :

1. Flexible conduits at motor connections

1.02 VIBRATION ISOLATION AND NOISE CONTROL REQUIREMENTS

A. Flexible Electrical Connections:

1. At connections to motors or other vibrating equipment

1.03 DEFINITIONS

A. The CBC: California Building Code.

B. CC-ES: ICC-Evaluation Service.

C. 2019 California Building Code (CBC).

1.04 PERFORMANCE REQUIREMENTS

A. Seismic restraints are to be based upon the prevailing building code.

PART 2 - PRODUCTS

2.01 FLEXIBLE CONNECTIONS

A. For conduit under 1 inch OD: Use "flexible" conduit with slack at least 3 feet or 15 diameters long, whichever is the longer or provide a flexible coupling as defined above.

PART 3 - EXECUTION

3.01 INSTALLATION OF VIBRATION ISOLATION DEVICES:

A. Install vibration isolators per manufacturer's directions.

B. Flexible electrical connections.

1. Electrical connections to all vibration isolated equipment shall be flexible, and made a way which does not impair or restrain the function of the aforementioned vibration isolation system.

C. All vibration isolation devices, including auxiliary steel bases shall be designed and furnished by a single manufacturer or supplier, who will be responsible for adequate coordination of all phases of this work.

D. Vibration Isolation Hangers

1. The isolators shall be installed with the isolator hanger box as close as possible to the structure.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

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.

1.02 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.03 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 electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

1.04 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with ANSI A13.1and IEEE C2.

B. Comply with CEC.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with CECE and Section 26 05 73 "Short Circuit, Coordination and Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service' feeder and branch-circuit conductors.

1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Color for Neutral: White.
4. Color for Equipment Grounds: Green.
5. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: To include "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification Labels:

1. Black letters on a white field for equipment connected to normal power and Red letters on a white field for equipment connected to emergency/standby power unless otherwise indicated

2.03 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyesterflexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Grafoplast Wire Markers.
    c. Ideal Industries, Inc.
    d. Marking Services, Inc.
    e. Panduit Corp.
    f. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Grafoplast Wire Markers.
    c. HellermannTyton.
    d. Ideal Industries, Inc.
    e. Marking Services, Inc.
    f. Panduit Corp.
    g. Seton Identification Products.

2. Minimum Nominal Size:

    a. 1-1/2 by 6 inches for raceway and conductors.
    b. 3-1/2 by 5 inches for equipment.
    c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. HellermannTyton.
    c. Marking Services, Inc.
    d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Panduit Corp.

2.05 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. HellermannTyton.
c. Ideal Industries, Inc.
d. Marking Services, Inc.
e. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. HellermannTyton.
b. LEM Products Inc.
c. Marking Services, Inc.
d. Seton Identification Products.

D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.

b. Seton Identification Products.

E. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Ideal Industries, Inc.
c. Marking Services, Inc.
d. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "CAUTION BURIED ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "CAUTION BURIED TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE" .

4. Tag: Type IID:

a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 6 inches.
c. Overall Thickness: 5 mils.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 34 lb./1000 sq. ft.
f. Tensile according to ASTM D 882: 300 lbf and 12,500 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be inchunless otherwise indicated. If requested by Architect, match Owner's existing legend type, size etc.

2.06 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.
e. Seton Identification Products.

2.07 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Champion America.
c. emedco.
d. Marking Services, Inc.

2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.

2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. in., minimum 1/16 inch thick.
b. For signs larger than 20 sq. in., 1/8 inch thick.
c. Engraved legend with black letters on white face background for equipment connected to normal power and red letters on white face background for equipment connected to emergency/standby power. Verify with Architect if legend has to match Owner's existing signs.
d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer. Refer to drawings for additional information.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."

M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose UV-stabilized cable ties for all area except use plenum-rated cable ties in plenum areas.

Y. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose UV-stabilized in all areas except use plenum-rated cable ties in plenum areas.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

AA. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

BB. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.

1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals unless otherwise indicated.

D. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

I. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

J. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

K. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

L. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

M. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

N. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with CEC and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

P. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

Q. Arc Flash Warning Labeling: Self-adhesive labels.

R. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

S. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

T. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign. Stenciled legend 4 inches high shall also be provided when requested by Architect.

3. Equipment to Be Labeled:

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.
   f. Emergency system boxes and enclosures.
   g. Enclosed switches.
   h. Enclosed circuit breakers.
   i. Remote-controlled switches, dimmer modules, and control devices.
   j. Battery-inverter units.
   k. Monitoring and control equipment.

END OF SECTION

SECTION 26 05 72

OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of Low Voltage (LV) circuit protective devices.

1.02 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. RMS: Root Mean Square

E. SCCR: Short-circuit current rating.

F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.03 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form on a CD and include one print copy in a three ring binder.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified California registered professional engineer.

    a. Submit study report for action prior to receiving final approval of the power distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from College Representative for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Software Developer, Short-Circuit Study Specialist and Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.05 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, registered and licensed in State of California with minimum ten years' experience in performing OC Protective Device Short Circuit Studies for facilities of similar size and scope. The study specialist shall be located within 75 miles radius of the project and be available to meet on short notice. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated at site, that is a member company of the InterNational Electrical Testing Association (NETA) and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE

A. ETAP Program.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.02 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following for normal and emergency/standby power system:

1. LV Protective device designations and ampere ratings including fuses.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Variable Speed Drives
7. Motor controllers

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices shown on single line diagrams and compare to short-circuit ratings. Include existing devices which are part of the primary electrical system to remain and are to be reconnected to the new equipment under this project.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Medium Voltage and Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.

d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.
2) Based on calculated symmetrical value multiplied by 1.6.
3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2, 3, 5, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2, 3, 5, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of University's Representative.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
4. For existing equipment reconnected to a new power source.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by the engineer who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.

7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.02 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less and to mechanical equipment control panel where fault current is 5kA or less.
2. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Medium and Low-voltage switchgear.
4. Motor controllers.
5. Variable Frequency Drives.
6. Control panels.
7. Branch circuit panelboards.
8. Disconnect switches and Circuit Breakers.

3.03 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.04 DEMONSTRATION

A. Train University's operating and maintenance personnel in the use of study results.

END OF SECTION

SECTION 26 05 73

SHORT CIRCUIT, COORDINATION AND ARC FLASH STUDIES

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.

1.02 SUMMARY

A. This Section includes computer-based, fault-current, overcurrent protective device coordination studies and arc flash study. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.03 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.04 ACTION SUBMITTALS

A. COORDINATION STUDIES

1. Product Data: For computer software program to be used for studies.
2. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form if requested by the architect/engineer.
3. Coordination-study input data, including completed computer program input data sheets.
4. Study and Equipment Evaluation Reports.
5. Coordination-Study Report.

B. SHORT CURCUIT STUDIES

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

    a. Short-circuit study input data, including completed computer program input data sheets.
    b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
    c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

C. ARC FLASH STUDIES

1. Product Data: For computer software program to be used for studies.
2. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
3. Arc-flash study input data, including completed computer program input data sheets.
4. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For power systems analysis specialist.

B. Product Certificates: For coordination-study, fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

D. Power Systems Analysis Software Developer

E. Qualification Data: For Field Adjusting Agency

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. The following are from the Coordination Study Report:

   a. Final one-line diagram.
   b. Final protective device coordination study.
   c. Coordination study data files.
   d. List of all protective device settings.
   e. Time-current coordination curves.
   f. Power system data.

2. The following are from the Short-Circuit Study Report:

   a. Final one-line diagram.
   b. Final Short-Circuit Study Report.
   c. Short-circuit study data files.
   d. Power system data

3. The following are from the Arc Flash Hazard Report:

   a. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
   b. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.07 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Power Systems Analysis Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Operation Technology, Inc. (ETAP)
2. SKM Systems Analysis, Inc.(Power Tools)

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399, IEEE 1584 and NFPA 70E.

B. Analytical features of fault-current-study, device coordination study and arc flash study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Generator kilovolt amperes, size, voltage, and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    f. Busway ampacity and impedance.
    g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.

h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.03 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Distribution panelboard.
3. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current according to IEEE 551.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.

1. Transformers:

a. ANSI C57.12.10.
b. ANSI C57.12.22.
c. ANSI C57.12.40.
d. IEEE C57.12.00.
e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.04 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 242 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

3.05 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination study prior to starting the Arc-Flash Hazard Analysis.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium-and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.06 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 73.13 "Short-Circuit Studies."

F. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

G. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

3.07 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

a. Arc-flash boundary.
b. Restricted approach boundary.
c. Limited approach boundary.

4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

D. Apply a label to each piece of equipment addresses by the study.

END OF SECTION

SECTION 26 09 13

ELECTRICAL POWER MONITORING AND CONTROL

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.

1.02 SUMMARY

A. Section includes the following for monitoring and control of electrical power system:

1. PC-based workstation(s) and software.
2. Communication network and interface modules for RS-232 RS-485, Modbus TCP/IP data transmission protocols.

B. Related Sections:

1. Section 262713 "Electricity Metering" for equipment to meter electricity consumption and demand for tenant submetering.

1.03 DEFINITIONS

A. Ethernet: Local area network based on IEEE 802.3 standards.

B. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

C. HTML: Hypertext markup language.

D. I/O: Input/output.

E. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.

F. LAN: Local area network; sometimes plural as "LANs."

G. LCD: Liquid crystal display.

H. Low Voltage: As defined in CEC for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.

I. Modbus TCP/IP: An open protocol for exchange of process data.

J. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

K. PC: Personal computer; sometimes plural as "PCs."

L. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

M. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.

N. RS-485: A TIA standard for multipoint communications using two twisted-pairs.

O. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

P. THD: Total harmonic distortion.

Q. UPS: Uninterruptible power supply; used both in singular and plural context.

R. WAN: Wide area network.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.

B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Outline Drawings: Indicate arrangement of components and clearance and access requirements.
2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
5. Surge Suppressors: Data for each device used and where applied.

C. Sustainable Design Submittals:

1. Product Data: Indicating that computers used by the system are certified by ENERGY STAR.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer manufacturer.

B. Field quality-control reports.

C. Other Informational Submittals:

1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Operating and applications software documentation.
2. Software licenses.
3. Software service agreement.
4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

1.07 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. Addressable Relays: One for every 10 installed. Furnish at least one of each type.
2. Data Line Surge Suppressors: One for every 10 of each type installed. Furnish at least one of each type.
3. I/O Protection Fuses: One for every 10 of each type installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

1.09 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide Veris E51H5 power meter.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by Veris.

2.02 FUNCTIONAL DESCRIPTION

A. Instrumentation and Recording Devices: Monitor and record load profiles and chart energy consumption patterns.

1. Calculate and Record the Following:

a. Load factor.
b. Peak demand periods.

B. Power Quality Monitoring: Identify power system anomalies and measure, display, and record trends and alarms of the following power quality parameters:

1. Voltage regulation and unbalance.
2. Continuous three-phase rms voltage.
3. Periodic max./min./avg. voltage samples.
4. Harmonics.

5. Voltage excursions.

C. System: Report equipment status.

2.03 SYSTEM REQUIREMENTS

A. Monitoring and Control System: Include with its operating system and application software, connected to the College's Energy Management System.

B. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

C. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

D. DDC Interface: Provide factory-installed hardware and software to enable the DDC to monitor, display, and record data for use in processing reports.

1. Hardwired Monitoring Points: Electrical power demand (kilowatts), electrical power consumption (kilowatt-hours), power factor.
2. ASHRAE 135 (BACnet) communication interface with the DDC shall enable the DDC operator to remotely monitor meter information from a DDC operator workstation. Control features and monitoring points displayed locally at metering panel shall be available through the DDC BAS.

2.04 OPERATING SYSTEM

A. Software: Configured for a server and multiple client PCs, each with capability for accessing multiple devices simultaneously. Software shall include interactive graphics client and shall be Web enabled. Portable computers shall not require any software except for an Internet browser to provide connectivity and full functionality. Include a firewall recommended by manufacturer.

2.05 COMMUNICATION COMPONENTS AND NETWORKS

A. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

2.06 POWER MONITORS

A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL 1244.

1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in non-temperature-controlled spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. RMS Real-Time Measurements:

1. Current: Each phase, neutral, average of three phases, percent unbalance.
2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
3. Power: Per phase and three-phase total.
4. Reactive Power: Per phase and three-phase total.
5. Apparent Power: Per phase and three-phase total.
6. Power Factor: Per phase and three-phase total.
7. Displacement Power Factor: Per phase and three-phase total.
8. Frequency.
9. THD: Current and voltage.
10. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
11. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
12. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

D. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:

1. Present.
2. Running average.
3. Last completed interval.
4. Peak.

E. Demand Real Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

F. Demand Reactive Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

G. Demand Apparent Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.

5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

H. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:

1. Last completed interval.
2. Coincident with kW peak.
3. Coincident with kVAR peak.
4. Coincident with kVA peak.

I. Power Analysis Values:

1. THD, Voltage and Current: Per phase, three phase, and neutral.
2. Displacement Power Factor: Per phase, three phase.
3. Fundamental Voltage, Magnitude and Angle: Per phase.
4. Fundamental Currents, Magnitude and Angle: Per phase.
5. Fundamental Real Power: Per phase, three phase.
6. Fundamental Reactive Power: Per phase.
7. Harmonic Power: Per phase, three phase.
8. Phase rotation.
9. Unbalance: Current and voltage.
10. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 63rd harmonic.

J. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:

    a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
    b. Fixed block that calculates demand at end of the interval.
    c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.

3. Demand Calculation Initiated by a Synchronization Signal:

    a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
    b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
    c. Demand can be synchronized with clock in the power meter.

K. Sampling:

1. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.

2. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.

L. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:

1. Line-to-line voltage.
2. Line-to-neutral voltage.
3. Current per phase.
4. Line-to-line voltage unbalance.
5. Line-to-neutral voltage unbalance.
6. Power factor.
7. Displacement power factor.
8. Total power.
9. Total reactive power.
10. Total apparent power.
11. THD voltage L-L.
12. THD voltage L-N.
13. THD current.
14. Frequency.

M. Harmonic Calculation: Display and record the following:

1. Harmonic magnitudes and angles for each phase voltage and current through 63rd harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by user.

N. Current and Voltage Ratings:

1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall not be less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Designed for use with voltage inputs from standard instrument potential transformers with a 120-V secondary.

O. Accuracy:

1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters. Accuracy from Light to Full Rating shall meet the following criteria:

a. Power: Accurate to 0.25 percent of reading, plus 0.025 percent of full scale.
b. Voltage and Current: Accurate to 0.075 percent of reading, plus 0.025 percent of full scale.
c. Power Factor: Plus or minus 0.002, from 0.5 leading to 0.5 lagging.
d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.

2. For meters that are circuit-breaker accessories, metering accuracy at full-scale shall not be less than the following:

    a. Current: Plus or minus 2.5 percent.
    b. Voltage: Plus or minus 1.5 percent.
    c. Energy, Demand, and Power: Plus or minus 4.0 percent.
    d. Frequency: Plus or minus 1 Hz.

P. Waveform Capture:

1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.
2. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

Q. Input: One digital input signal(s).

1. Normal mode for on/off signal.
2. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
3. Conditional energy signal to control conditional energy accumulation.

R. Outputs:

1. Operated either by user command sent via communication link or set to operate in response to user-defined alarm or event.
2. Closed in either a momentary or latched mode as defined by user.
3. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
4. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.
5. One relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
6. Output Relay Control:

    a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
    b. Normally open and normally closed contacts, field configured to operate as follows:
        1) Normal contact closure where contacts change state for as long as signal exists.
        2) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
        3) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
        4) End of power demand interval when relay operates as synchronization pulse for other devices.
        5) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
        6) Output controlled by multiple alarms using Boolean-type logic.

S. Onboard Data Logging:

1. Store logged data, alarms, events, and waveforms in 800 KB of onboard nonvolatile memory.
2. Stored Data:

    a. Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 and 52 days of 15-minute interval data, depending on number of quantities selected.
    b. Custom Data Logs: Three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:
        1) Schedule interval.
        2) Event definition.
        3) Configured as "fill-and-hold" or "circular, first-in first-out."

    c. Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
    d. Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."

3. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

T. Alarms.

1. User Options:

    a. Define pickup, dropout, and delay.
    b. Assign one of four severity levels to make it easier for user to respond to the most important events first.
    c. Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.

2. Alarm Events:

    a. Over/undercurrent.
    b. Over/undervoltage.
    c. Current imbalance.
    d. Phase loss, current.
    e. Phase loss, voltage.
    f. Voltage imbalance.
    g. Over kW demand.
    h. Phase reversal.
    i. Digital input off/on.
    j. End of incremental energy interval.
    k. End of demand interval.

U. Control Power: 90- to 457-V ac or 100- to 300-V dc.

V. Communications:

1. Power monitor shall be permanently connected to communicate via Modbus TCP via a 100 Base-T Ethernet or RS-485 Modbus TCP/IP.
2. Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.

W. Display Monitor:

1. Backlit LCD to display metered data with touch-screen selecting device.
2. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
3. Display four values on one screen at same time.

    a. Current, per phase rms, three-phase average and neutral.
    b. Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
    c. Real power, per phase and three-phase total.
    d. Reactive power, per phase and three-phase total.
    e. Apparent power, per phase and three-phase total.
    f. Power factor, per phase and three-phase total.
    g. Frequency.
    h. Demand current, per phase and three-phase average.
    i. Demand real power, three-phase total.
    j. Demand apparent power, three-phase total.
    k. Accumulated energy (MWh and MVARh).
    l. THD, current and voltage, per phase.

4. Reset: Allow reset of the following parameters at the display:

    a. Peak demand current.
    b. Peak demand power (kW) and peak demand apparent power (kVA).
    c. Energy (MWh) and reactive energy (MVARh).

2.07 STANDALONE, WEB-ENABLED MONITORING AND CONTROL INSTRUMENT

A. Separately mounted, permanently installed instrument for power monitoring and control.

1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability.

1. Indoor installation in nontemperature-controlled spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. Power-Distribution Equipment Monitor: Web enabled, with integral network port and embedded Web server with factory-configured firmware and HTML-formatted Web pages for viewing of power monitoring and equipment status information from connected devices equipped with digital communication ports.

D. LAN Connectivity: Multipoint, RS-485 Modbus serial communication network, interconnecting all breaker trip units, protective relays, drives, and metering devices equipped with communications. Serial communication network connected to Ethernet server that functions as a gateway and server, providing data access via 100 Base-T LAN.

E. Communication Devices within the Equipment: Addressed at factory and tested to verify reliable communication with network server.

F. Server Configuration:

1. Initial network parameters set using a standard Web browser. Connect via a local operator interface, or an RJ-45 port accessible from front of equipment.
2. Network server shall be factory programmed with embedded HTML-formatted Web pages that are user configurable and that provide detailed communication diagnostic information for serial and Ethernet ports as status of RS-485 network; with internal memory management information pages for viewing using a standard Web browser.
3. Login: Password protected; password administration accessible from the LAN using a standard Web browser.
4. Operating Software: Suitable for local access; firewall protected.

G. Data Access:

1. Network server shall include embedded HTML pages providing real-time information from devices connected to RS-485 network ports via a standard Web browser.

H. Equipment Monitoring Options: Login shall be followed by a main menu for selecting summary Web pages that follow.

I. Summary Web pages shall be factory configured to display the following information for each communicating device within the power equipment lineup:

1. User-Configured Custom Home Page: Provide for the lineup, showing status-at-a-glance of key operating values.
2. Circuit Summary Page: Circuit name, three-phase average rms current, power (kW), power factor, and breaker status.
3. Load Current Summary Page: Circuit name, Phase A, B, and C rms current values.
4. Demand Current Summary Page: Circuit name, Phase A, B, and C average demand current values.
5. Power Summary Page: Circuit name, present demand power (kW), peak demand power (kW), and recorded time and date.
6. Energy Summary Page: Circuit name, energy (kWh), reactive energy (kVARh), and time/date of last reset.
7. Transformer Status Page: Transformer tag, coil temperatures, and cooling fan status.
8. Motor-Control Center Status Page: Circuit name, three-phase average rms current, thermal capacity (percentage), and drive output frequency (Hz) contactor status.
9. Specific Device Pages: Each individual communicating device shall display detailed, real-time information, as appropriate for device type.

    a. Display historical energy data that shall be logged automatically for each device, as appropriate for device type.
    b. Display historical data logged from each device in graphical time-trend plots. Value to be displayed on time-trend plot shall be user selectable. Time interval to be displayed on scale shall be for previous day or week.

10. Export historical energy data to a PC or workstation through network using FTP (File Transfer Protocol). Format exported data in a CSV (Comma Separated Variable) file format for importing into spreadsheet applications.

J. Communications:

1. Power monitor: Permanently connected to communicate via RS-485 Modbus TCP/IP or Modbus TCP via a 100 Base-T Ethernet.
2. Local Plug-in Connections: RS-232 and 100 Base-T Ethernet.
3. Monitor Display: Backlighted LCD to display metered data with touch-screen.

2.08 RS-232 ASCII INTERFACE

A. ASCII interface shall allow RS-232 connections to be made between a meter or circuit monitor operating as the host PC and any equipment that will accept RS-232 ASCII command strings, such as local display panels dial-up modems and alarm transmitters.

B. Pager System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.

1. RS-232 output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to paging system. This interface shall support both numeric and alphanumeric pagers.

C. Alarm System Interface:

1. RS-232 output shall be capable of transmitting alarms from other monitoring and alarm systems to workstation software.

D. Cables:

1. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

   a. CEC, Type CM.
   b. Flame Resistance: UL 1581, Vertical Tray.

2. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

   a. CEC, Type CMP.
   b. Flame Resistance: NFPA 262, Flame Test.

2.09 LAN CABLES

A. Comply with Section 27 10 00 "Communication Cabling".

B. RS-485 Cable:

1. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and CEC, Type CMG.
2. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket, and CEC, Type CMP.

C. Unshielded Twisted Pair Cables: Category 6 as specified for horizontal cable for data service in Section 27 10 00 "Communication Cabling".

2.10 LOW-VOLTAGE WIRING

A. Comply with Section 26 05 23 "Control-Voltage Electrical Power Cables."

B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.

1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CABLING

A. Comply with NECA 1.

B. Install cables and wiring according to requirements in Section 27 10 00 "Communication Cabling".

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

D. Install LAN cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.

E. Install cables without damaging conductors, shield, or jacket.

3.03 IDENTIFICATION

A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."

B. Label each power monitoring and control module with a unique designation.

3.04 GROUNDING

A. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:

1. Electrical Tests: Use caution when testing devices containing solid-state components.
2. Continuity tests of circuits.
3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.

    a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
    b. Test LANs according to requirements in Section 27 10 00 "Communication Cabling".
    c. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
    d. Verify accuracy of graphic screens and icons.
    e. Metering Test: Load feeders, measure loads on feeder conductor with a rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
    f. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

E. Power monitoring and control equipment will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Correct deficiencies make necessary adjustments, and retest. Verify that specified requirements are met.

H. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

I. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

J. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. See Section 01 79 00 "Demonstration and Training."

3.07 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 09 43

NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes a networked lighting control system comprised of the following components

1. System Software Interfaces
2. System Backbone and Integration Equipment
3. Wired Networked Devices
4. Wireless Mesh Networked Devices
5. Wireless Dual-Band Networked Devices
6. The networked lighting control system shall meet all of the characteristics and performance requirements specified herein.
7. The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

1.02 RELATED DOCUMENTS

A. Section 26 27 26 Wiring Devices

B. Section 26 51 00 LED Interior Lighting

1.03 SUBMITTALS

A. Submittal shall be provided including the following items.

1. Bill of Materials necessary to install the networked lighting control system.
2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
3. Riser Diagrams showing device wiring connections of system backbone and floor plans pertinent to the specific project. Engineers design drawings returned back to the Engineer for review are not acceptable.

1.04 APPROVALS

A. Prior approval from owner’s representative is required for products or systems manufactured by companies not specified in the Network Lighting Controls section of this specification.

B. Any alternate product or system that has not received prior approval from the owner's representative at least 10 days prior to submission of a proposal package shall be rejected.

C. Alternate products or systems require submission of catalog datasheets, system overview documents and installation manuals to owner's representative. The submittal shall include significant differences between the specified product and the alternate.

1.05 QUALITY ASSURANCE

A. Product Qualifications

1. System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
2. System luminaires and controls shall be designed and manufactured for interoperability.
3. All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
4. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

B. Installation and Startup Qualifications

1. System start-up shall be performed by qualified personnel approved or certified by the manufacturer.

C. Service and Support Requirements

1. Phone Support: Toll free technical support shall be available.
2. Remote Support: The bidder shall offer a remote support capability.
3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.06 PROJECT CONDITIONS

A. Only install equipment after the following site conditions are maintained:

1. Ambient Temperature: 14 to 105˚F.
2. Relative Humidity: less than 90% non-condensing

B. Equipment shall not be subjected to dust, debris, moisture, or temperature and humidity conditions exceeding the requirements indicated above, at any point prior to installation.

C. Only properly rated equipment and enclosures, installed per the manufacturer's instructions, may be subjected to dust and moisture following installation.

1.07 WARRANTY

A. The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.

B. The hardware warranty shall cover repair or replacement, including programming, any defective products within the warranty period.

1.08 MAINTENANCE & SUSTAINABILITY

A. The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

PART 2 - EQUIPMENT

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. nLight, Acuity Brands Lighting, Inc.

B. Basis of Design System: Acuity Controls nLight

2.02 SYSTEM COMPLIANCE

A. System components shall comply with UL 916 and UL 924 standards where applicable.

B. System components shall comply with CFR Title 47, Part 15 standards where applicable.

C. All equipment shall be installed and connected in compliance with CEC.

2.03 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) optional system backbone for remote, time based and global operation between control zones.
2. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 10V input, and manual wallstation capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
3. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system

backbone (see Control Zone Characteristics sections for each type of network connection, wired or wireless).

4. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wallstations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”

5. The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type.
6. Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties.
7. Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.
8. Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.
9. The system may include one or more system controllers that provide time-based control and global system control across multiple control zones and backbone network segments. The system controller also provides a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP protocol.
10. The system may include “communication bridge” devices that route communication from lighting control zones (wired or wireless) to and from the system controller, for purposes of decreasing system wiring requirements.
11. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.

B. Wired Networked Control Zone Characteristics

1. Connections to devices within a wired networked lighting control zone and to backbone components shall be with a single type of low voltage network cable, which shall be compliant with CAT5e specifications or higher. To prevent wiring errors and provide cost savings, the use of mixed types of low voltage network cables shall not be permitted.
2. Devices in an area shall be connected via a “daisy-chain” topology; requiring all individual networked devices to be connected back to a central component in a “hub-and-spoke” topology shall not be permitted, so as to reduce the total amount of network cable required for each control zone.
3. System shall provide the option of having pre-terminated plenum rated low voltage network cabling supplied with hardware so as to reduce the opportunity for improper wiring and communication errors during system installation.
4. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system start-up and programming requirements and to also have functional lighting control operation prior to system start-up and programming.
5. Once software is installed, system shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.

6. All networked devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/start-up personnel.
7. Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:

C. Wireless Mesh Networked Control Zone Characteristics

1. No wired control connections between wireless networked devices shall be required.
2. Wireless networked devices shall communicate via radio frequency of 2.4 GHz using a standards-based wireless mesh networking protocol.
3. Wireless network shall be self-healing, such that optimum routing paths between devices are automatically established or restored if any nodes are respectively added to or removed from the wireless network.
4. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wallstation signal.
5. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wallstations to networked luminaires and wireless load control devices, without requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.
6. All wireless communication shall be encrypted using the 128-bit Advanced Encryption Standard (AES).
7. Wet listed wireless networked luminaires and wireless sensing devices shall be offered, to support a wide variety of lighting control applications.
8. Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:

D. Wireless Dual Band Networked Control Zone Characteristics

1. No wired connections between wireless networked devices shall be required.
2. Wireless networked devices shall communicate using two radio frequencies, 900 MHz and 2.4 GHz.
3. Multiple wireless networking protocols shall be supported:

4. Wireless network shall be self-healing, such that optimum communication between devices is automatically established or restored if any nodes are respectively added to or removed from the wireless network.
5. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wallstation signal.
6. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wallstations to networked luminaires and wireless load control devices, without requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.
7. All wireless communication shall support the following five tiers of security measures, so as to safely support Internet-connected applications.

8. Accounting for typical environmental conditions and building construction materials encountered within commercial indoor lighting environments, wireless mesh networked devices shall be capable of communicating to at least 300’ spacing between luminaires with embedded wireless transceivers.
9. Wireless networked devices shall have a line-of-sight communication range of at least 1000 ft. under ideal environmental conditions.

E. System Integration Capabilities

1. The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols. The following system integration capabilities shall be available via BACnet/IP and BACnet/MSTP protocols:

F. Supported Sequence of Operations

1. The following characteristics and performance requirements shall apply to wired and wireless control zones provided by the system.
2. Control Zones

3. Wallstation Capabilities

4. Occupancy Sensing Capabilities

5. Photocell Sensing Capabilities (Automatic Daylight Sensing)

6. Schedule and Global Profile Capabilities

7. Automated demand response capabilities. Profiles created for automated demand response events shall support automatic reduction of light level to programmable values. At least four levels of demand response profiles shall be supported by the system.

2.04 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. Management interface shall require all users to login with a User Name and Password and shall support creation of at least 100 unique user accounts.
4. Management interface shall support at least three permission levels for users: read-only, read & change settings, and full administrative system access.
5. Management interface shall be capable of restricting read-only and read & change access for user accounts to specific devices within the system.
6. All system devices shall be capable of being given user-defined names.
7. The following device identification information shall be displayed in the Management interface: model number, model description, serial number, manufacturing date code custom label(s), and parent network device.

8. Management interface shall be able to read the live status of a networked luminaire or intelligent control device and shall be capable of displaying luminaire on/off status, dim level, power measurement, device temperature, PIR occupancy sensor status, microphonic occupancy sensor status, remaining occupancy time delay, photocell reading, and active Scenes or Profiles.
9. Management interface shall be able to read the current active settings of a networked luminaire or intelligent control device and shall be capable of displaying dimming trim levels, occupancy sensor and photocell enable/disable, occupancy sensor time delay and light level settings, occupancy sensor response (normal or vacancy), and photocell setpoints and transition time delays.
10. Management interface shall be able to change the current active settings and also default settings for an individual networked luminaire or intelligent control device.
11. Management interface shall be capable of applying settings changes for a zone of devices or a group of selected devices using a single “save” action that does not require the user to save settings changes for each individual device.
12. A printable network inventory report shall be available via the management interface.
13. A printable report detailing all system profiles shall be available via the management interface.
14. All sensitive information stored by the software shall be encrypted.
15. All system software updates must be available for automatic download and installation via the Internet.

B. Historical Database and Analytics Interface

1. System shall provide a historical database that stores device operational history and calculates energy usage for all networked luminaires and intelligent control devices.
2. System shall be capable of reporting lighting system events and performance data back to the historical database for display and analysis.
3. Historical database shall be capable of recording historical data for up to 20,000 networked devices for a period of at least 1 calendar year.
4. An “Energy Scorecard” shall be displayed that shows calculated energy savings in dollars, kWh, or CO2.
5. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc.).
6. Energy savings data shall be calculated for the system as a whole, or for individual zones.
7. A time scaled graph showing all relay transitions shall be presented.
8. A time scaled graph showing a zones occupancy time delay shall be presented
9. A time scaled graph showing the total light level shall be presented.
10. User shall be able to customize the baseline run-time hours for a space.
11. User shall be able to customize up to four time-of-day billing rates and schedules.
12. Historical data shall be exportable from the Historical Database via a “CSV” type of file format.

C. Visualization Interfaces

1. System shall provide a web-based visualization interface that displays graphical floorplan.
2. Graphical floorplan shall offer the following types of system visualization:

D. Personal Control Applications

1. Software interface shall support personal control software applications that provide user-specific control of individual luminaires, control zones, and scene presets.
2. Personal control applications shall support control of dimming output or definition of dimming presets for luminaires and devices that are dimmable.

3. The system administrator shall be capable of defining personal control permissions for each user account.
4. Software interface shall provide a Microsoft Windows® operating system taskbar application for personal lighting control.
5. Software interface shall provide an Apple iOS® operating system application (supported by mobile phones and mobile tablet devices) for personal lighting control.

E. Smartphone Programming Interface for Wired Devices

1. Application interface shall be provided for both Apple iOS® and Android operating systems that allows configuration of lighting control settings.
2. The application shall support the configuration of wired networked control devices via a Bluetooth® Low Energy (BLE) Programming Device.

3. Programming capabilities through the application shall include, but not be limited to, the following:

2.05 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. IP nLight ECLYPSE™ System Controller (IP-NE-CTRL)

1. System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall have 32-bit microprocessor operating at a minimum of 1 GHz.
3. System Controller shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases.
4. System Controller shall perform the following functions:

5. System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.
6. Device shall have option for a graphical touch screen to support configuration and diagnostics.
7. Device shall have three RJ-45 networked lighting control ports for connection to any of the following:

8. Device shall be capable of communicating with wireless mesh network bridges and software interfaces via LAN connection.
9. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
10. Device shall have a standard internal time clock.
11. Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection

12. Device shall have 2 x USB 2.0 Expansion ports for

13. Each System Controller shall be capable of managing and operating at least 1500 networked devices (wired or wireless).

14. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.

B. OpenADR Interface

1. System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
2. OpenADR interface shall meet all of the requirements of Open ADR 2.0a Virtual End Nodes (VEN), including:

3. OpenADR interface shall support the activation of system profiles configured for each of the automated demand response levels defined in the utility demand response program.

2.06 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
3. All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
4. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
5. Devices with mechanical push-buttons shall be made available with custom button labeling.
6. Wall switches & dimmers shall support the following device options:

7. Scene controllers shall support the following device options:

B. Wired Networked Graphic Wallstations

1. Device shall surface mount to single-gang switch box.
2. Device shall have a 3.5” full color touch screen.
3. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
4. Device shall have a micro-USB style connector for local computer connectivity.
5. Communication shall be over standard low voltage network cabling with RJ-45 connectors.
6. Device shall enable user supplied screen saver image to be uploaded within one of the following formats: jpg, png, gif, bmp, tif.
7. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
8. Graphic wallstations shall support the following device options:

C. Wired Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½ in knockout.
2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
3. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:

D. Wired Networked Occupancy and Photosensors

1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
4. 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.
5. All sensing technologies shall be acoustically passive, meaning they do not transmit sound 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.
6. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
7. All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
8. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
9. Network system shall have ceiling, fixture, recessed & corner mounted sensors available, with multiple lens options available customized for specific applications.
10. Sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
11. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
12. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
13. Photosensor 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.
14. Photosensor 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.
15. 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).
16. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The secondary daylight zone shall be capable of being controlled as an "offset" from the primary zone.

E. Wired Networked Wall Switch Sensors

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
3. All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
4. Devices with mechanical push-buttons shall provide tactile user feedback.
5. Wall switches sensors shall support the following device options:

F. Wired Networked Embedded Sensors

1. Network system shall have embedded sensors consisting of occupancy sensors and/or dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
2. Occupancy sensor detection pattern shall be suitable for 7.5 ft. to 20 ft. mounting heights.
3. Embedded sensors shall support the following device options:

G. Wired Networked Power Packs and Secondary Packs

1. Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
3. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output but shall not be required to contribute system power.
4. Power Supplies shall provide system power only but are not required to switch line voltage circuit.
5. Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
6. Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
7. Power Pack programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
8. Power Pack shall securely mount to junction location through a threaded ½ in chase nipple or be capable of being secured within a luminaire ballast/driver 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.
9. 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.
10. Power/Secondary Packs shall be available with the following options:
11. Power Pack capable of full 16-Amp switching of all normal power lighting load types, with optional 0-10V dimming output capable of up to 100mA of sink current.
12. Secondary Pack with UL924 listing for switching of full 16-Amp Emergency Power circuits, with optional 0-10V dimming output capable of up to 100mA of sink current.
13. Power and Secondary Packs capable of full 20-Amp switching of general-purpose receptacle (plug-load) control.
14. Secondary Pack capable of full 16-Amp switching of all normal power lighting load types.
15. Secondary Pack capable of 5-Amps switching and dimming 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and3-wire versions).
16. Secondary Pack capable of 5-Amps switching and dimming of 120/277 VAC magnetic low voltage transformers.
17. Secondary Pack capable of 4-Amps switching and dimming of 120 VAC electronic low voltage transformers.
18. Secondary Pack capable of louver/damper motor control for skylights.
19. Secondary Pack capable of providing a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
20. Secondary Pack capable of switching 1 amp at 40 VAC/VDC (resistive only) with the intent to provide relay signal to auxiliary system (e.g. BMS).

21. Power Supply capable of providing auxiliary bus power (no switched or dimmed load).

H. Wired Networked Relay and Dimming Panel

1. Relay and dimming panel shall be available with 4, 8, 12 or 16 individual Field Configurable Relays (FCR) per panel, with an equal number of individual 0-10V dimming outputs.
2. Standard relays used shall have the following required properties:

3. 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
4. Relay and dimming outputs shall be individually programmable to support all standard sequence of operations as defined in this specification.
5. Panel shall be UL924 listed for control of emergency lighting circuits.
6. Panel shall power itself from an integrated 120-277VAC or 347VAC supply.
7. Panel shall provide a configurable low-voltage sensor input with the following properties:
8. Configurable to support any of the following input types:

9. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel. This input is intended to provide an interface to alarm systems, fire panels, or BMS system to override the panel.
10. Panel shall supply current limited low voltage power to other networked devices connected via low voltage network cable.
11. Panel shall be available with NEMA 1 rated enclosure with the following properties:

12. Panel shall be rated from 32-122 °F.

I. Wired Networked Bluetooth® Low Energy Programming Device

1. Device shall be plenum rated and be inline wired, screw mountable.
2. Communication and low voltage power shall be delivered to device via standard low voltage network cabling with RJ-45 connectors.
3. Bluetooth Low Energy connection shall allow connection from smartphone application for programming device settings within the local daisy-chain zone (see list of available settings in section, 2.4-System Software Interfaces, Sub-section .5).

J. Wired Networked Communication Bridge

1. Device shall surface mount to a standard 4” x 4” square junction box.
2. Device shall have 8 RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or powered via low voltage network connections from powered lighting control devices (e.g. power packs).
5. Wired Bridge shall be capable of redistributing power from its local supply and connected 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.

2.07 WIRELESS MESH NETWORKED DEVICES

A. Wireless Mesh Networked Sensor Interface

1. The wireless sensor interface shall integrate industry standard low voltage switching devices and contact closure outputs into the control network.
2. The device interface shall have a universal power supply that operates at 120, 208, 240 or 277 VAC.
3. The device shall be listed under the UL 916 standard to allow field installation.
4. The device interface shall be suitable for mounting onto an electrical junction box and have UL 2043 listing for mounting in a plenum.
5. The device interface shall provide 2 low voltage sensing input channels suitable for connecting to momentary contact wall switches and dry contact outputs from other systems.
6. The device shall provide at least 100 mA of output power at 24VDC for connection to external input devices.
7. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.

B. Wireless Mesh Networked Light Controllers

1. The wireless light controller shall have a line voltage relay and 0-10V dimming output suitable for control of commercial and industrial lighting including fluorescent, HID, induction and LEDs.
2. Device shall have a form factor similar to a slim European-style ballast, which is intended for installation directly inside the ballast channel of a fixture.
3. Device shall have an integrated internal antenna suitable for embedding inside of a commercial and industrial luminaire while maintaining reliable wireless communication for typical luminaire spacing in commercial and industrial applications (see Wireless Mesh Network Control Zone Characteristics). An external antenna attached to the luminaire shall not be allowed.
4. The wireless light controller shall have a universal power supply that operates at 120, 208, 240 or 277VAC.
5. The device shall be listed under the UL 916 standard to allow field installation.
6. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.
7. The wireless light controller shall have a connector for an optional digital occupancy sensor and photocell.
8. Wireless light controller shall have the following relay options:

C. Wireless Mesh Networked Digital Sensor Attachments

1. Digital sensor attachments provide integrated digital occupancy sensing and digital photocell sensor.
2. Devices shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
3. IP-rated digital sensor attachments shall be provided that maintain wet-location capability of a luminaire.
4. Device shall have software-adjustable sensitivity of PIR occupancy sensor.
5. Photocell shall be suitable for closed and open loop applications.
6. Device shall have a user button that may be used to provide diagnostic and factory-default reset capabilities.
7. Digital sensor attachment shall have the following form factors and lens types:

D. Wireless Mesh Networked Sensor-Controllers

1. Sensor-Controllers shall integrate the following functions in to a single enclosure:

2. Sensor-Controllers shall mount to luminaires or junction boxes with a secured chase nipple suitable for ½ in KO mounting holes.
3. Sensor-Controllers shall have optional IP-rated enclosures for wet location applications.
4. Sensor-Controllers shall be the following enclosures, relay options, and lens types:

E. Wireless Mesh Network Communication Bridge

1. A communication bridge device shall be provided that interfaces with the System Controller via LAN connection and interfaces with wireless mesh networked devices via an integrated2.4 GHz transceiver.
2. Device shall provide an option to be powered from a Power-over-Ethernet connection conforming to the IEEE 802.3af standard.
3. Device shall provide an option to be powered from 120VAC electrical outlet.
4. Device shall consume no more than 6 W of power.
5. Device shall be capable of communicating with a group of at least 250 wireless mesh networked devices and luminaires, so as to reduce the amount of communication bridges required in the system.
6. Device shall be supplied with mounting hardware suitable for wall mounting in an office environment or utility closet.
7. Device shall have optional IP-rated enclosure suitable for wet location applications.
8. Device shall have optional heated enclosure suitable for below-freezing applications.
9. To provide security, the wireless bridge shall be unresponsive to wired and wireless communication that do not conform to the specific protocols used by the networked lighting control system.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Installation Procedures and Verification

1. The successful bidder shall review all required installation and pre-startup procedures with the manufacturer’s representative through pre-construction meetings.
2. The successful bidder shall install and connect the networked lighting control system components according to the manufacturer’s installation instructions, wiring diagrams, the project submittals and plans specifications.
3. The successful bidder shall be responsible for testing of all lighting control low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:

B. Coordination with Owner’s IT Network Infrastructure

1. The successful bidder is required to coordinate with the owner’s representative to secure all required network connections to the owner’s IT network infrastructure.

C. Documentation and Deliverables

1. The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.
2. The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package.

3.02 SYSTEM STARTUP

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.

1. Low voltage network cable testing shall be performed prior to system startup.

B. System start-up and programming shall include:

1. Verifying operational communication to all system devices.
2. Programming the network devices into functional control zones to meet the required sequence of operation.
3. Programming and verifying all sequence of operations.
4. Customization of owner's software interfaces and applications.

C. Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.03 PROJECT TURNOVER

A. System Documentation and as-builts.

1. Submit software database file with desired device labels and notes completed.

B. Owner Training

1. Provisions for onsite training for owner and designated attendees to be included in submittal package. Training shall be a minimum of (1) day and shall be videotaped by the Contractor, and video provided to the Owner.
2. Contractor shall include in their bid a second training to occur (6) months after occupancy of building by the Owner. The second training shall be a minimum of (4) hours.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

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.

1.02 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

B. Related Sections include the following:

1. Section 26 05 53 “Identification for Electrical Systems”.
2. Section 26 05 73 "Overcurrent Protective Device Coordination Study" for short-circuit rating of devices and for setting of overcurrent protective devices.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RMS: Root mean square.

D. SPDT: Single pole, double throw

E. SPD: Surge Protective Device

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 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."
2. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest California Building Code (CBC).
3. Square D; a brand of Schneider Electric

4. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
5. Siemens Energy & Automation, Inc..
6. Coordinate two paragraphs below with Drawings. See the "Disconnecting and Overcurrent Protective Devices" Article in the Evaluations for guidance on making selections.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Where indicated provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
2. Thermal-Magnetic Circuit Breakers (below 400A frame): Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Provide field adjustable magnetic trip setting for circuit-breakers serving motor loads or other special applications as indicated
3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
4. Electronic trip circuit breakers (400A frame size and larger) with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.
    e. CBs shall have an integral power supply installed at the factory if required for proper functioning of the breaker. An external power supply shall not be acceptable.

5. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes RMS symmetrical at 240 volts, and 14,000 amperes RMS symmetrical at 480 volts, unless otherwise noted on the drawings. Verify maximum available fault levels from the Short Circuit and Coordination Study. Minimum interrupting rating (AIC) shall be 110% of the available fault level.
6. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
7. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
8. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
9. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
10. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    f. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

g. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

D. All panelboards shall have double hinged covers.

1.05 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 2 - EXECUTION

2.01 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

2.02 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated. Mounting height of Over Current Protective Devices shall be 6”7” above finished floor to the center of the grip of device operating handle unless a lower height is indicated or required by code.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

K. Comply with NECA 1.

2.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

2.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:
        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

2.05 ADJUSTING

A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated in Section 26 05 72 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

2.06 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 27 13

ELECTRICITY METERING

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.

1.02 SUMMARY

A. Section includes equipment for electricity metering by the College.

1.03 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

B. PC: Personal computer.

1.04 ACTION SUBMITTALS

A. Product Data: Manufacturer's technical data for each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Application and operating software documentation.

2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in CEC and marked for intended location and application.

B. Owner's Meters in switchgear/switchboard/distribution board shall be installed by the manufacturer at the factory.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.09 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted in writing under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify College no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without College's written permission.
3. Comply with CECE.
4. Provide temporary standby power through a standby diesel quiet type back-up generator complete with fuel and 7/24 monitoring if the existing service interruption exceeds 2 hours. Coordinate additional requirements with owner minimum fourteen days in advance. Indicate method of providing temporary electric service.

1.10 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years from the date of acceptance of the project by the owner.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion.

Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software at no additional cost to the owner.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

PART 2 - PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Square D; a brand of Schneider Electric
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution
4. Electrotech Industries

B. General Requirements for Owner's Meters:

1. Comply with UL 1244.
2. Meters used for billing shall have an accuracy of 0.2 percent of reading, complying with requirements in ANSI C12.20.
3. Meters shall be certified by California Type Evaluation Program as complying with Title 4, California Code of Regulations, Article 2.2.
4. Enclosure: NEMA 250, Type 1minimum, with hasp for padlocking or sealing.
5. Meters installed outdoor shall be in NEMA 4X stainless steel enclosure. Meter in enclosure shall be factory installed and assembled with strip heaters controlled by thermostat.
6. Identification: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
7. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
8. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
   a. Type: Split and solid core.
9. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
10. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.

C. Kilowatt-hour Meter: Electronic three-phase meters, measuring electricity used.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.

D. Kilowatt-hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand[, and time and date of historic peak demand]. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.

E. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 26 05 23 "Control-Voltage Electrical Power Cables."

F. Software: PC based, a product of meter manufacturer, suitable for calculation of utility cost allocation and billing.

G. Accessories:

1. Fuses: Provide fuses to protect meters.
2. Shunting Devices: Provide shunting devices for maintenance of meters.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

D. Install arc-flash labels as required by CEC.

E. Wiring Method:

1. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 27 15 13 "Communications Copper Horizontal Cabling."
3. Minimum conduit size shall be 1/2 inch (13 mm).

3.02 IDENTIFICATION

A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by CEC.

2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for [printed, weather-resistant card] [typewritten card] with occupant's name.

3.03 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.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results. This shall be done in the presence of College’s Meter Shop Personnel. Coordinate through College’s Representative.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

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.

1.02 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. USB receptacles.
3. Tamper-resistant receptacles.
4. Weather-resistant receptacles.
5. Snap switches and wall-box dimmers.
6. Solid-state fan speed controls.
7. Wall-switch and exterior occupancy sensors.
8. Toggle switches, 120/277 V,20 A.
9. Decorator-style devices, 20 A.
10. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.03 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

E. RFI: Radio-frequency interference.

F. SPD: Surge Protective Device.

G. UTP: Unshielded twisted pair.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.08 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Switches, receptacles and cover plates shall be of the same manufacturer.

B. Comply with National Electrical Manufacturer’s Association (NEMA) standards. Furnish products listed and classified by Underwriter's Laboratories Inc. as suitable for purpose specified and shown.

C. Manufacturer shall have a minimum of ten (10) years experience in the production of wiring devices specified and shall have ISO 9001 and 9002 certifications.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
2. Leviton Mfg. Company Inc. (Leviton).
3. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: UL Listed and labeled and marked for intended location and application.

B. Comply with CEC.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD 6 Configuration 5-20R, UL 498, and FSW-C-596.

1. Products: Subject to compliance with requirements, provide one of the following manufacturers

a. Hubbell; HBL5361 (single), HBL5362 (duplex).
b. Leviton; 5361 (single), 5362 (duplex).
c. Pass & Seymour; 5361 (single), 5362 (duplex).

2. Description: Grounded, industrial extra heavy-duty specifications grade, back- and side-wired, single-piece grounding brass strap with integral ground, impact-resistant thermoplastic nylon cover and body, smooth face, 20A, 125V, duplex, with separate grounding screw, NEMA 5-20R plug configurations and stainless-steel face plate.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding, integral shutters that operate only when a plug is inserted in the receptacle, square face and stainless-steel face plate.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.

C. Controlled Quad Receptacles, 125 V, 20A

1. Description: Two pole, three wire and self-grounding, square face and stainless-steel face plate.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Shall have permanent marking per CEC 130.5 (d).
5. Standards: Comply with UL 1310 and USB 3.0 devices.

D. USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system, square face and stainless-steel face plate.
2. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

E. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system,square face and stainless-steel face plate. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
2. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
3. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
5. Marking: Listed and labeled as complying with CEC, "Tamper-Resistant Receptacles" Article.
6. Pedestal mounted: Flush type with one duplex receptacle and two USB ports.

2.04 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type, square face and stainless/steel face plate.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
4. Include self-test feature so that the outlet is automatically tested every fifteen minutes.
5. Outlets used in coastal environments shall be suitable for such applications and shall be properly protected against the ambient conditions.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following manufacturers~~:~~

a. Hubbell; GFR5352L.
b. Pass & Seymour; 2095.
c. Leviton; 7590.

2.05 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.06 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. All plates shall be of stainless steel construction.
2. Plate-Securing Screws: Metal with head color to match plate finish.
3. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel 0.05-inch- (1.2-mm-) thick, anodized aluminum.
4. Material for Unfinished Spaces: Galvanized steel.
5. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable in-use cover.

C. Antimicrobial Cover Plates:

1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

2.07 FLOOR SERVICE FITTINGS

A. Type: Modular, flap-type, above-floor, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Per Technology documents.

2.08 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Stainless steel.

B. Wall Plate Color: Stainless steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of CEC, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle, sensor, and switch with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 20-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports. Submit reports within two (2) weeks of completion of tests.

END OF SECTION

SECTION 26 28 13

FUSES

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.

1.02 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches panelboards switchboards enclosed controllers and motor-control centers.
2. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
3. Spare-fuse cabinets.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.05 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with CEC.

E. Comply with UL 248-11 for plug fuses.

1.07 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.08 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.

2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.03 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.04 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.05 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch (38-mm) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, fast acting.
2. Feeders: Class L, fast acting.
3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class RK1, time delay.
5. Control Circuits: Class CC, fast acting or time delay.

B. Plug Fuses:

1. Motor Branch Circuits: Edison-base type, single-element time delay.
2. Other Branch Circuits: Edison-base type, single-element fast acting.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s).

3.04 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers 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."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, 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.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

E. Comply with CEC.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect Construction Manager Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's Construction Manager's Owner's written permission.
4. Comply with CECE.

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.02 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.03 RECEPTACLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240 and 600-V ac, 30, 60, 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Single-Throw Non-fusible Switch: 24,0 600-V ac, 30, 60, 100 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.04 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with CEC and NECA 1.

3.03 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 72 "Overcurrent Protective Device Coordination Study."

END OF SECTION

SECTION 26 51 00

LED INTERIOR LIGHTING

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.

1.02 SUMMARY

A. Section includes the following types of LED luminaires:

1. Exit signs.
2. Downlight.
3. Recessed troffers.
4. Strip light.
5. Suspended, linear.
6. Suspended, nonlinear.

B. Related Requirements:

1. Section 26 09 43 network lighting control systems with low-voltage control wiring or data communication circuits.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project, IES LM-79 and IES LM-80.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire 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.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.

1. Include Samples of luminaires and accessories involving color and finish selection.

E. Samples for Verification: For each type of luminaire.

1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule: For luminaires and lamps, refer to light fixture schedule on plans.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.

c. Speakers.
d. Sprinklers.
e. Access panels.
f. Ceiling-mounted projectors.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, 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.

D. Product Certificates: For each type of luminaire Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency and as follows:

1. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted.
2. Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.
3. ISTMT (IN SITU TEMPERATATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.
4. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).

E. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by 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, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
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.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, product(s) indicated on drawings.

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

C. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).

1. Relative Humidity: Zero to 95 percent.

D. Altitude: Sea level to 1000 feet.

2.03 DRIVERS FOR LED FIXTURES

A. Electronic Driver for LED Fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. Include the following features unless otherwise indicated:

1. Rated for 50,000 hours of life, unless otherwise noted.
2. Sound Rating: Class A.
3. Total Harmonic Distortion Rating: 15 percent or less.
4. Current Crest Factor: 1.5 or less.
5. 0-10V Dimming Standard (Step Dimming does not qualify)

2.04 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. California Title 24 compliant.

2.05 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.06 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

2.07 DOWNLIGHT

A. Lamp:

1. Minimum allowable efficacy of 80 lm/W.
2. CRI of minimum 80. CCT of 4000K.
3. Rated lamp life of 50,000 hours to L70.
4. Dimmable from 100 percent to 0 percent of maximum light output.
5. Internal driver.
6. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

B. Housings:

1. Extruded-aluminum, stainless steel, or per plans, Steel housing and heat sink.
2. Clear, anodized, powder-coat finish.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Additional Diffusers and Globes:

1. Fixed, Adjustable lens.
2. Spot, Medium, Wide light distribution.

E. Standards:

1. Recessed luminaires shall comply with NEMA LE 4.

2.08 RECESSED LUMINAIRES

A. Lamp:

1. Minimum allowable efficacy of 80 lm/W.
2. CRI of minimum 80. CCT of 4000K.
3. Rated lamp life of 50,000 hours to L70.
4. Dimmable from 100 percent to 0 percent of maximum light output.
5. Internal driver.
6. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

B. Housings:

1. Extruded-aluminum, stainless steel, or per plans, Steel housing and heat sink.
2. Clear, anodized, powder-coat finish.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent

doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Additional Diffusers and Globes:

1. Fixed, Adjustable lens.
2. Spot, Medium, Wide light distribution.

E. Standards:

1. Recessed luminaires shall comply with NEMA LE 4.

2.09 STRIP LIGHT

A. Lamp:

1. Minimum allowable efficacy of 80 lm/W.
2. CRI of minimum 80. CCT of 4000K.
3. Rated lamp life of 50,000 hours to L70.
4. Dimmable from 100 percent to 0 percent of maximum light output.
5. Internal driver.
6. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

B. Housings:

1. Extruded-aluminum, stainless steel, or per plans housing and heat sink.
2. Clear, anodized, powder-coat, finish.
3. With integral mounting provisions.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping of luminaire without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.10 SUSPENDED, LINEAR AND NONLINEAR

A. Lamp:

1. Minimum allowable efficacy of 80 lm/W.
2. CRI of minimum 80. CCT of 4000K.
3. Rated lamp life of 50,000 hours to L70.
4. Dimmable from 100 percent to 0 percent of maximum light output.
5. Internal driver.
6. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

B. Housings:

1. Extruded-aluminum, stainless steel, or per plans housing and heat sink.
2. Clear, anodized, powder-coat, finish.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.11 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A 240/240 M.

D. Galvanized Steel: ASTM A 653/A 653M.

E. Aluminum: ASTM B 209.

2.12 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.13 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.01 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 luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls Attached to a minimum 20-gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:

a. Two 5/32-inch diameter aircraft cable supports adjustable to 10 feet in length.
b. Pendant mount Four-point pendant mount with 5/32-inch diameter aircraft cable supports adjustable to 10 feet in length.
c. Hook mount.

2. Pendants and Rods: Where longer than 24 inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod or wire support for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 26 09 43 "Addressable-Luminaire Lighting Controls."

B. Comply with requirements for startup specified in Section 26 09 43 "Network Lighting Controls".

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 26 56 00

LED EXTERIOR LIGHTING

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.

1.02 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 26 09 43 network lighting control systems with low-voltage control wiring or data communication circuits.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project and testing procedures and criteria required by IES LM-79 and LM-80.

    a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire 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.

C. Sustainable Design Submittals:

1. "BUG ratings" Light Pollution Reduction for both uplight and light trespass.

PRODUCT DATA: INDICATING LUMINAIRE IS CERTIFIED BY ENERGY STAR

D. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

E. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports and seismic restraints.

1.05 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. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.

7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, 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.

D. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

E. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted.Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.

F. ISTMT (IN SITU TEMPERATATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.

G. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).

H. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency as follows:

1. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted.
2. Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.
3. ISTMT (IN SITU TEMPERATATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.
4. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).

I. Source quality-control reports.

J. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaire to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.07 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by 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, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

F. Mockups: For exterior luminaires, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.

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.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures, including luminaire support components.
   b. Faulty operation of luminaires and accessories.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 5-years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61 or IEC 60061-1.

F. Bulb shape complying with ANSI C79.1.

G. CRI of minimum 80. CCT of 4000K.

H. L70 lamp life of 50,000 hours.

I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: 277 V ac, 12 V dc, 24 V dc.

L. In-line Fusing: On the primary for each luminaire.

M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

N. Source Limitations: Obtain luminaires from single source from a single manufacturer.

O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.03 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.04 LUMINAIRE TYPES

A. Area and Site:

1. Luminaire Shape: Round
2. Mounting: Pole
3. Luminaire-Mounting Height: See plans.
4. Distribution: See plans.

B. Bollard:

1. Shape: Round
2. Height Above Finished Grade: See plans.
3. Overall Height: See plans
4. Diameter: See plans.
5. Mounting: 3-point cast aluminum base.
6. Distribution: See plans.
7. Diffusers and Globes: per plans

MATERIALS

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

F. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

G. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

H. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

I. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2. Provide filter/breather for enclosed luminaires.

J. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.05 FINISHES

A. Variations in Finishes: 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.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: See plans, or as selected by Architect.

2.06 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.01 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 luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls, Attached to a minimum 1/8 inch backing plate attached to wall structural members.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.04 BOLLARD LUMINAIRE INSTALLATION:

A. Align units for optimum directional alignment of light distribution.

1. Install on concrete base with top above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.05 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.06 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.07 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.08 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

a. IES LM-5.
b. IES LM-50.
c. IES LM-52.
d. IES LM-64.
e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.10 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 27 10 00

COMMUNICATIONS CABLING

PART 1 - GENERAL

1.01 GENERAL INTRODUCTION

A. The work shall consist of the design, provision, termination, testing and documentation of a complete and fully functional structured high-performance copper and optical fiber communications cabling system. The instructions in this section are specific to communications installations and should be read in conjunction with other contract documents as applicable.

1.02 DEFINITIONS

A. Throughout this specification, the following definitions will apply:

1. Provide: Supply, furnish, deliver, install, pull, fix, dress, terminate, label, test, ground and document the components as per these specifications.
2. BDF (Building Distribution Frame) Rooms, are special-purpose rooms that provide space and maintain a suitable operating environment for the termination of backbone and campus cabling and house centralized communications and/ or computer equipment (such as Core Switches and Servers).
3. IDF (Intermediate Distribution Frame), or Tele/Data Rooms are floor-serving spaces that provide a connection point between backbone and horizontal distribution pathways.
4. Backbone Cables: Cables linking the BDF and the IDF.
5. Horizontal Cables: Cables linking the IDF to each workstation outlet.
6. External Cables: Cables that link the building to external connection point(s) and/or other building(s). These cables are considered to be Outside Plant (OSP).
7. Station Cables: Cables linking workstation outlet to active equipment.
8. Client: MiraCosta Community College District
9. Architect: Per project
10. Consultant: Project consultant
11. Bidder: A company invited to bid for the works
12. Installer/Contractor: The Company installing the equipment as defined in this specification
13. Construction Manager / Owner’s Representative

1.03 MANUFACTURER’S COMPLETE SYSTEMS

A. The cabling system specified in this document shall be an end to end solution that is sourced from a single manufacturer or partnered manufacturers. Unless explicitly noted within these specifications, this shall include patch panels, connectors, cables, patch cords, faceplates and other associated components.

B. Where it is specified that a system be provided by “manufacturer xxx or equal”, a substitution of another manufacturer’s products will only be considered for a complete end to end solution of equal quality, as determined by the Owner’s Representative. All substitutions shall conform to

the substitution requirements detailed in the specifications. In instances where these specifications do not include the statement “or equal” for a particular component or system, substitutions will not be entertained.

1.04 JOB CONDITIONS

A. Prior to bidding visit the site and determine all existing conditions affecting work. The Bidder shall examine all drawings and specifications to familiarize themselves with the type of construction to be used, and the nature and extent of work provided by other trades.

B. Verify dimensions and the correct location of hardware before proceeding with the installation of hardware, cabling and/or connections.

C. Notify the Owners' Representative in writing immediately on discovery of dimensional discrepancies and other conditions detrimental to proper performance of the Work.

1.05 PERSONNEL

A. The personnel who will be employed on the contract shall be suitably trained in the management of a project of this nature and/or in the installation and maintenance of products of the type being provided so as to be able to carry out all work in a competent manner.

B. The Installer shall provide a site manager responsible for all site-related issues. This individual shall be the single point of contact for the project team and shall carry a mobile phone so they can be contacted during the working hours of the project.

C. The Installer shall be certified by the component manufacturer(s) in the installation and testing of the cabling system and shall be able to provide a manufacturers’ extended performance warranty for the ‘end to end’ cabling system.

1.06 LABELING AND NUMBERING SCHEME

A. Labeling of the cabling system shall be in accordance with EIA/TIA 606 for the Administration of the Telecommunications Infrastructure for Commercial Buildings.

1.07 WARRANTY

A. Installer to provide a warranty for one year from Notice of Completion on all materials and workmanship installed or supplied as part of the cabling system.

B. The Installer shall also supply an extended performance warranty, as offered by the components’ manufacturer(s).

1.08 QUALITY

A. The 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 required. The Owner's Representative may conduct scheduled or unscheduled inspections of the Contractor's work at anytime 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.

B. All installation work shall be completed to the standard of the samples approved by the Owners 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 Owner's Representative at no additional cost to the Owner.

1.09 STANDARDS

A. All materials provided by the Installer shall meet the requirements of the following where applicable:

1. National Electrical Manufacturer's Association (NEMA)
2. American National Standards Institute (ANSI)
3. Underwriters Laboratories, Inc. (UL)
4. ETL

B. All products, services and documentation provided by the Installer shall meet the requirements of the following where applicable:

1. California Electrical Code (CEC)
2. Relevant State Electric and Fire Codes
3. ANSI/EIA/TIA 568-1.D Commercial Building Telecommunications Wiring Standard
4. ANSI/EIA/TIA 569-D Commercial Building Standard for Telecommunications Pathways and Spaces
5. ANSI/EIA/TIA 606-C The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
6. ANSI/EIA/TIA 607-C Commercial Building Grounding and Bonding Requirements for Telecommunications
7. Building Industry Consulting Service International (BICSI) publications:
    a. Information Technology Systems Installation Methods Manual (ITSIMM), 7th Edition
    b. Telecommunications Distribution Methods Manual (TDMM), 14th Edition
    c. Outside Plant Design Reference Manual (OSPDRM), 6th Edition
8. Manufacturer's recommendations and installation guidelines including but not limited to:
    a. Belden CSV Installation Guidelines
    b. Chatsworth (CPI) Installation Guidelines
    c. 3M Installation Guidelines

C. All publications referred to in this document shall be the latest edition.

1.10 SUBMITTALS

A. All submittals shall be sent to the Construction Manager / Owner's Representative for initial processing and distribution. Three copies of each submittal should be provided unless otherwise noted. Each submittal should be provided no later than six weeks prior to the work associated with that submittal to allow time for submittal review.

B. Project References

1. Submit for approval, references for a minimum of three similar projects successfully undertaken and completed within the last three years. These projects should be a similar scale, complexity and have similar time scales as this project.
2. Provide project name and address, client contact name and telephone number and construction manager name and telephone number. Provide a brief description of each project indicating types of system installed, quantities and configurations of outlets and project time scales.
3. At least two of the references shall be located in Southern California and shall be available for the Owners Representative and other members of the Design Team to visit and inspect the installation, should, in the opinion of the Owners Representative, this be necessary.
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.

C. Personnel Training

1. 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.
2. 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.
3. Submit records to confirm that the personnel that will be responsible for testing the system are suitably trained in the operation of the test equipment being used in this project.
4. These records are required to ensure that the Installer is 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.

D. Cabling Diagram

1. Submit, for approval, a complete cabling diagram. The diagram shall be based on the singleline drawing included in the Construction Documents. It shall be updated to show quantities and part numbers for all components including patch panels, cable, conduit, cabinets and equipment racks, splices, splice cases and all other associated components.

E. Test Equipment

1. Submit, for approval, details of each item of test equipment to be used to test the optical fiber and copper components. Include patch cords and other specialized components.

F. Product Literature/Data Sheets

1. Submit for approval manufacturer's product data sheets for each component of the telephone and data cabling systems. Certify that the data sheets depict the components to be provided by the Installer to make up the complete system as described in this specification.

G. Component Samples and Mock-ups

1. Provide one full size installation sample mock-up of a normal wall faceplate for approval. All samples are to be fully labeled as per these specifications. Samples are to be delivered to the Construction Manager's office on site prior to installation.
2. All sample mock-ups are intended to represent the components that are to be installed as part of this project; therefore, 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, inspected by the Owners' Representative and approved, they shall be retained. The samples will be used as the standards by which the quality of work on the project by the Installer shall be judged. 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.

H. As-Built Documentation (required upon completion of the work)

1. Following completion of the installation, submit the following record drawings, documentation and testing for approval.
2. As-Built Drawings

   a. As-built drawings showing locations of telephone, Technology Rooms and data outlets, backbone, link and external cable routes, data rack locations, telephone termination board locations and station identification.
   b. Provide laminated copies of as-builts on site in each Technology Room.

3. Final Test Results

   a. Test results for each cable indicating tests performed, results obtained and values measured.

4. All documentation and drawings shall be provided in an un-locked acceptable electronic format. AutoCAD (at least R14) for drawings, MS Excel (for schedules) and supplied ona USB Drive.

PART 2 - PRODUCTS

2.01 HORIZONTAL CROSSCONNECT TERMINATED COPPER CABLING

A. Provide Belden DataTwist 4800 series, or approved equal from Siemon or Commscope Systimax, Category 6 UTP Cable. Each cable shall have four pairs of unshielded twisted-pair solid copper conductors. The cable shall be plenum-rated (CMP). Each cable shall meet or exceed the performance specifications in this document when installed as part of the end to end cabling system described in this specification.

B. The high performance copper cabling system shall meet or exceed the performance specifications for Category 6 cabling as detailed in EIA/TIA 568-C.2. This covers all Category 6 components installed as a part of the installation.

C. Voice copper cables shall be white in color.

2.02 HORIZONTAL INTERCONNECT TERMINATED COPPER CABLING

A. Data Outlets: Provide Belden DataTwist 4800 series, or approved equal from Siemon or Commscope Systimax, Category 6 UTP Cable. Each cable shall have four pairs of unshielded twisted-pair solid copper conductors. The cable shall be plenum-rated (CMP). Each cable shall meet or exceed the performance specifications in this document when installed as part of the end to end cabling system described in this specification.

1. The high-performance copper cabling system shall meet or exceed the performance specifications for Category 6 cabling as detailed in EIA/TIA 568-1.D This covers all Category 6 components installed as a part of the installation.
2. Data copper cables shall be black in color.

B. Wireless Access Points: Provide Belden 10GX or 10GXW series, or approved equal from Siemon or Commscope Systimax, Category 6A UTP Cable. Each cable shall have four pairs of unshielded twisted-pair solid copper conductors. The cable shall be plenum-rated (CMP). Each cable shall meet or exceed the performance specifications in this document when installed as part of the end to end cabling system described in this specification.

1. The high-performance copper cabling system shall meet or exceed the performance specifications for Category 6A cabling as detailed in EIA/TIA 568-1.D This covers all Category 6A components installed as a part of the installation.
2. Wireless Access Point copper cables shall be blue in color.

C. Exterior cables or cables run in conduits beneath the vapor barrier of a slab-on-grade must be rated indoor / outdoor and contain water-blocking agents.

2.03 LINK COPPER CABLING

A. Provide Belden 10GX or 10GXW, or approved equal from Siemon or Commscope Systimax, Category 6A UTP Cable. Each cable shall have four pairs of unshielded twisted-pair solid copper conductors. The cable shall be plenum-rated (CMP). Each cable shall meet or exceed the performance specifications in this document when installed as part of the end to end cabling system described in this specification.

B. The high-performance copper cabling system shall meet or exceed the performance specifications for Category 6A cabling as detailed in EIA/TIA 568-1.D This covers all Category 6A components installed as a part of the installation.

C. Link copper cables colors shall be verified with the Owner prior to procurement of materials.

2.04 OPTICAL FIBER CABLES

A. All site fiber is Sumitomo FutureFlex Air Blown Fiber in Sumitomo indoor or outdoor tube cable (Sole Source).

B. Where Sumitomo FutureFlex cannot be installed (in existing occupied conduits or pathways) a tight-buffered indoor / outdoor OS2 tight buffered optical fibers within a dry water blocked cable core. Confirm with District ITS prior to using non-Sumitomo fiber optic cable

C. Singlemode Cable (OS2) Elements shall conform to the following specification:

1. 8.3 micron core diameter, 125 micron cladding diameter (+/- 1 micron)
2. Mode field diameter of between 8.7 and 9.3 (with +/- 0.5 micron tolerance) at 1310 nm
3. Attenuation coefficient at 1310 nm of 1.0 db/km or less
4. Attenuation coefficient at 1550 nm of 1.0 db/km or less
5. Cladding non-circularity of +/- 1%
6. Core to cladding concentricity error of no more than 0.8 micron
7. Maximum dispersion rate of 2.80 ps/nm-km at 1300 nm
8. Maximum dispersion rate of 17.00 ps/nm-km at 1550 nm
9. Individual glass elements proof tested at 100 kpsi (100,000 lbs. per square inch)
10. Number of elements as indicated on the drawings

2.05 WORK AREA CONNECTORS

A. Provide Belden GigaFlex PS6+, or approved equal from Siemon or Commscope Systimax to match cabling manufacturer for compliance with the end-to-end system warranty, eight-position modular RJ45 jacks. Each connector shall meet or exceed the channel performance specifications in this document when installed as part of the end to end cabling system described in this specification. The pin outs for the jack shall conform to the T568B wiring scheme.

B. Work area connectors shall be blue for all communications ports.

C. Provide additional 15% spare work area connectors.

2.06 PATCH PANELS

A. Data Patch Panels. Provide Belden GigaFlex PS6+ or CAT 6A, or approved equal from Siemon or Commscope Systimax to match cabling manufacturer for compliance with the end-to-end system warranty, Patch Panels (AX101613) conforming to the following specification:

1. Suitable for mounting in standard EIA 19" racks.
2. Configured with 48 jacks housed in each 2U (3.5") of usable rack space.
3. Provide strain relief for each cable terminated on the connector at the rear of the patch panel.
4. Allow for labeling of each individual connector.
5. Allow any individual cable to be terminated or otherwise handled without disturbing other cables.

B. Link Patch Panels. Provide Belden CAT 6A or approved equal from Siemon or Commscope Systimax to match cabling manufacturer for compliance with the end-to-end system warranty, Modular Patch Panels conforming to the following specification:

1. Suitable for mounting in standard EIA 19" racks.
2. Configured with 48 jacks housed in each 2U (3.5") of usable rack space.
3. Provide strain relief for each cable terminated on the connector at the rear of the patch panel.
4. Provide Category 6A connectors, colors to be verified with Owner, for each cable installed.
5. Allow for labeling of each individual connector.
6. Allow any individual cable to be terminated or otherwise handled without disturbing other cables.

C. Rack Mounted Optical Fiber Patch Panel. Provide Belden FiberExpress optical fiber patch panel, conforming to the following specification:

1. Each panel shall be suitable for installation in EIA 19" mounting frame.
2. Configured with 72 connectors housed in each 4U (7") of usable rack space.
3. Allow for labeling of each individual connector.
4. Allow any individual cable to be terminated or otherwise handled without disturbing other cables.
5. Each panel shall provide fiber handling for fiber elements, including 36" fiber reserve (service loop) inside the patch panel with no bends sharper than 2" bend radius.
6. Provide blanking adapter plates to cover all unused spaces as necessary.
7. Belden FiberExpress Manager Connector Module with Zirconia ceramic, singlemode, 12 fibers (LC duplex).
8. Belden Field Breakout Kit
9. Belden Blank Adapter Panel

D. Provide 25% additional capacity in patch panels.

2.07 OPTICAL FIBER CONNECTORS

A. Singlemode Optical Fiber Connectors. Provide fusion-spliced factory manufactured pig-tails, no equal, LC optical fiber connectors, conforming to the following specification.

1. Duplex, handling one pair (two elements) per connector.
2. Blue in color.
3. Compatible with both 900 micron buffered strands and 250 micron loose tube strands.
4. Maximum insertion loss, of mated pair, less than 0.5 dB at acceptance.
5. Minimum return loss of greater than or equal to 50 dB.
6. Durability better than 500 matings, with a maximum increase in insertion loss of not more than 0.2 dB.
7. Meets ANSI/TIA/EIA 568-B and ISO 11801 standards.

2.08 PATCH CORDS

A. Provide two high performance copper patch cords per telecommunications outlet. These shall be sourced from the same manufacturer as the connectors provided as a part of this project. Each cord shall meet or exceed the performance specifications in this document when installed as part of the end-to-end cabling system described in this specification.

1. 30% of the patch cords shall be 1 feet in length and black in color
2. 10% of the patch cords shall be 3 feet in length and black in color

3. 40% of the patch cords shall be 7 feet in length and black in color
4. 20% of the patch cords shall be 11 feet in length and black in color

B. Optical Fiber. Provide one optical fiber patch cord per optical fiber pair installed. These shall be sourced from the same manufacturer as the optical fiber connectors provided as a part of this project. Each cord shall meet or exceed the optical fiber performance specifications in this document.

1. 20% of the patch cords shall be 1 meter in length and orange/aqua/yellow in color
2. 60% of the patch cords shall be 2 meters in length and orange/aqua/yellow in color
3. 20% of the patch cords shall be 3 meters in length and orange/aqua/yellow in color

C. The patch cords are to be passed to the client on completion of the project. Each cord is to have a manufacturer's certificate of conformance and shall be in its original, unopened packaging.

2.09 WORK AREA FACEPLATES

A. Wall-mounted Faceplate. Provide Belden MediaFlex (P/N: AX101747) or approved equal from Siemon or Commscope Systimax to match cabling manufacturer for compliance with the end-to-end system warranty, wall-mounted flush stainless steel modular faceplate to house work area jacks, capable of housing a minimum of four jacks. The faceplate shall fit over a standard NEMA electrical outlet box fitted with a single gang plaster ring cover and shall be office white in color.

B. Blanking Inserts. Provide blanking inserts, matching faceplates, in sufficient quantities to cover all unused openings in every faceplate.

C. Wallphone Faceplate. Provide a Belden MediaFlex, or approved equal from Siemon or Commscope Systimax to match cabling manufacturer for compliance with the end-to-end system warranty, wall-mounted flush stainless steel modular faceplate to house a single work area jack. The faceplate shall fit over a standard NEMA electrical outlet box fitted with a single gang plaster ring cover. The faceplate shall be capable of having a wall-mounted telephone fitted directly over it.

D. Furniture Faceplate. Provide a Belden MediaFlex, or approved equal from Siemon or Commscope Systimax to match cabling manufacturer for compliance with the end-to-end system warranty, flush-mounted modular faceplate to house work area jacks. The faceplate shall fit over a modular raceway.

E. Floor Box (or Poke-Through) Faceplate. Provide an internal blank bracket to house combinations of work area connectors in a flush-mounted floor box. The bracket shall be provided by the manufacturer of the flush floor box and shall be designed to fit in the floor box installed as a part of this project. The faceplate shall be similar to the Wall Mounted stainless steel faceplate or per floor unit metal (powder-coated) plate to fit within the enclosure. For additional combination multi-service floor box and poke-through information, refer to MCCCD standards Appendix Section 6-3.

2.10 LABELS

A. Provide labels for connectors, cables, outlets, termination frames and patch panels.

B. The lettering on each label shall be as large as is practicable. All labels shall be machine-produced. Hand-written labels will not be acceptable.

C. A standard relative orientation shall be adopted for all labels unless otherwise specified.

D. Labels shall be robust, durable, shall resist abrasion and shall be UV inhibiting, permanent and indelible. Labels shall be proof to 140 degrees Fahrenheit.

E. All labels shall be readily visible and shall be fixed so that they remain in a visible position wherever practical.

F. Labels shall carry the full complement of characters to designate the unique identifications for the item that they identify.

G. The faceplate labels are to be a white and black laser or thermal printed label, i.e. black letters on white background. Labels are to be placed below the clear plastic lens on the face plate.

H. The patch panel labels are to be a white and black adhesive-backed nylon thermal printed labels, i.e. black letters on white background. Labels are to be placed below the clear plastic lens on the face plate.

I. The Patch Panel labels shall be permanently fixed to the patch panel front cover with an epoxy adhesive

J. Cable Labels

1. Provide self-laminating wrap labels for cables with less than ½" diameter. The labels shall permanently fixed to each cable once they have been installed. Any labels that split, partially split or otherwise damaged shall be replaced.
2. Horizontal Cabling: Label each cable so that the label is within 8" of the end of the cable at the patch frame end and within 6" of the end of the cable at the outlet end.

2.11 EQUIPMENT CABINETS

A. Provide CPI Swing Gate Wall Rack, Equipment Cabinets PN# 11807-725 and include with Heavy Duty Swing Gate Kit, no equal.

2.12 CABLE SUPPORTS

A. Provide J-Hooks to support communications cables running in the ceiling void in locations where cable tray and/or conduit is not provided. J-Hooks to be B-Line, Mono Systems 'The Hook', Caddy 'Cable Cat' or approved equal.

2.13 MULTI-SERVICE POWER/DATA FLOOR BOX

A. Provide Legrand Wiremold RFB2 two-compartment recessed floor box for power and data services.

B. Include flush lid configured with color and trim material coordinated with the project architect for matching aesthetics.

2.14 MULTI-SERVICE POWER/DATA/AUDIOVISUAL FLOOR BOX

A. Provide Legrand Wiremold RFB11 deep floor box and pour-pan (as required) with multiple bays for services or equivalent from Legrand Wiremold. Separate high-voltage and low-voltage services maintaining data and Audiovisual together on one side or floor box and power on the opposite side. Data and Audiovisual conduits to be separate for dedicated services cabling.

B. Include flush lid configured for carpet/tile insert or solid surface with color and trim material coordinated with the project architect for matching aesthetics.

2.15 MULTI-SERVICE POWER/DATA/AUDIOVISUAL IN-WALL BOX (FLUSH)

A. Provide FSR, Inc. PWB-100 recessed in-wall enclosure behind displays with multiple bays for services. Separate high-voltage and low-voltage services maintaining data and Audiovisual together on the top side or wall box and power on the lower side. Data and Audiovisual conduits to be separate for dedicated services cabling.

B. Include white cover plate and prime/paint as required to match the wall finish schedule in coordination with the project architect for matching aesthetics.

2.16 EXTERNAL WIRELESS ENCLOSURE

A. Provide outdoor wireless access point and antenna concealment shroud.

1. Model 3001-00 as manufactured by Oberon, a division of Chatsworth Products, Inc.
2. Design: Rugged ABS plastic vanity cover, hinged to universal equipment mounting panel.
3. Performance: UV resistant vanity cover is virtually transparent to wireless signal
4. Construction: Stainless Steel 16 ga. wall mounting brackets and hardware,
5. ABS mounting panel, white ABS plastic cover with UV cap
6. Size: 14.25 x 22 x 11 in.
7. Prime and paint as required to match building finish - use RF-transparent water-based paint as recommended by MFG.

2.17 CODE BLUE PHONE

A. Provide new wall mounted Code Blue Phone to replace existing Emergency Phone location as shown on the plans.

1. Equipment shall be CB 4U Signature Help Point and shall include separate wall mounted blue beacon and Public Address accessory.
2. Unit shall be blue in color with reflective white lettering indicating “EMERGENCY”. Paint to have protective gloss coating for additional protection from salt air.
3. Unit shall have the IP500 IP intercom with “PUSH FOR HELP” button in the primary opening. Unit shall include a custom camera cutout for the secondary opening. Both opening plates shall have a clear coat for additional weatherized protection.
4. Unit shall include the battery backup for the IP500 Intercom.
5. Unit shall include the separate top “remote” Public Address and blue light stroke/ beacon accessory painted to match unit.

PART 3 - EXECUTION

3.01 HORIZONTAL CABLING AND COMPONENTS

A. Horizontal Cabling

1. Provide one four-pair high performance plenum-rated horizontal cable running from each work area connector to the patch panels located in the Technology Room serving that outlet. Terminate all four pairs of each end of each cable with an RJ45 communications connector using the EIA/TIA 568B.2 termination scheme.

B. Work Area Outlets

1. Standard Work Area Outlet. Each standard work area outlet will be a wall-mounted flush modular faceplate configured with (2) RJ45 connectors, unless otherwise noted. The faceplate shall fit over a deep NEMA electrical outlet box fitted with a single gang plaster ring cover and shall match the electrical faceplate color. Any unused faceplate opening shall contain a matching blanking insert.
2. Wall-phone Outlet. Each wall-phone outlet will be a wall-mounted flush modular faceplate to house a single (1) RJ45 connector. The faceplate shall fit over a deep NEMA electrical outlet box fitted with a single gang plaster ring cover and be capable of having a wall-mounted telephone fitted directly over it.
3. Furniture / Raceway Outlet. Each Furniture outlet will be a flush-mounted modular faceplate to house (4) RJ45 work area jacks as shown on the drawings. The faceplate shall fit over a modular raceway.
4. Floorbox Outlet. Each Floorbox outlet will be a flush-mounted modular faceplate to house (4) RJ45 work area jacks as shown on the drawings.
5. Audiovisual Station Outlet. Floor or wall to have 6 minimum (coordinate with MCCCD Media Services for actual quantity by system for a one-to-one networked device correlation).

3.02 OPTICAL FIBER AND HIGH-PERFORMANCE COPPER LINK CABLING

A. High Performance Copper Link Cable

1. Provide Category 6A high performance 4-pair cables running between each of the Telecommunications Rooms, as shown on the drawings. The high-performance cables shall not exceed 90 meters.
2. Terminate all four pairs of each end of each cable with an RJ45 communications connector fitted in a rack-mounted patch panel using the EIA/TIA 568B termination scheme. Label each connector with the link cable number.

3.03 EXTERNAL CABLING AND COMPONENTS

A. Optical Fiber Cabling

1. Provide external optical fiber running the Telecommunications Room to the MDF in the Library building B100, as shown on the drawings. Contractor shall use existing innerduct running from the nearest Communications Manhole to the MDF. Terminate each pair of optical fiber elements with the same optical fiber connectors used for the backbone

cabling system, fitted in an optical fiber rack-mounted patch panel. Label each connector with the backbone cable number.

2. Provide patch panels fitted in the equipment cabinet, racks, and/or wall-mounted as needed per project to house optical fiber cables terminated on optical fiber connectors.
3. Securely fix all patch panels in place.
4. Provide a sufficient number of patch panels to house all specified optical fiber cables and connectors.
5. Terminate all elements of each optical fiber cable with the specified connectors. Strip back the optical fiber cable jacket, providing a 36" service loop for each optical fiber element. Neatly dress these loops in the patch panel using appropriately sized spiral wrap, so they are protected.

3.04 TECHNOLOGY INFRASTRUCTURE

A. Data system equipment cabinets and racks

1. Provide equipment cabinets and racks, as shown on the drawings.
2. Securely fix the cabinets/racks in place.
3. Whenever cables are to enter the cabinets from above, provide a 12”x6” grommeted opening on the top of the cabinet.
4. Attach the power strip to the cabinet/rack. Ensure that the power strips are connecting to the cabinets/racks in such a way that the structural integrity of the cabinets/racks is not compromised. Connect the cabinet power strip to an appropriate power receptacle.
5. Fix each cabinet and rack to the floor and supporting walls to provide stability and prevent movement of the cabinet or rack. Fix adjacent racks and cabinets together.
6. Install the appropriate seismic transverse and longitudinal bracing per any local codes and the current NUSIG (National Uniform Seismic Installation Guidelines).

B. Conduit, Ladder Rack And J-Hook Installation

1. Where shown on the drawings, provide solid metal conduit to protect cable runs. Securely fix this conduit to structural elements at regular intervals. Provide couplings, end pieces, grommets and associated components to make up a complete conduit run. All conduit installation shall be done in accordance with the relevant CEC regulations. No L-bends (condulets) are to be installed; any bends in the conduit runs are to be provided using sweeps.
2. Where cables are installed in an open cabling method (i.e. J-Hooks) and encounter full height partitions or other obstructions, Contractor shall provide conduit sleeves. Conduits sleeves shall be sized and fire-stopped per all applicable national and local electric and fire codes.
3. Ladder rack. Where shown on the drawings, provide metal ladder rack to support equipment racks and route communications cabling.
4. J-Hooks. Where conduit or cable tray is not provided to support cable runs, provide J-Hooks fastened to the structural slab at 48” centers. J-Hooks shall not be attached to beams, ceiling tile tee grid or wire hangers used to support the ceiling grid. J-Hooks shall be attached to the slab using anchors and ¼” rod used exclusively for supporting J-Hooks. J-Hooks can be fixed to stud walls provided the cable load is no more than 10lbs per stud.
5. Install the appropriate seismic transverse and longitudinal bracing per any local codes and the current NUSIG (National Uniform Seismic Installation Guidelines).

C. Innerduct

1. Provide innerduct to protect air blown optical fiber cable runs. Securely fix the innerduct to structural elements at 36” centers. Provide couplings, end pieces, grommets and associated components to make up a complete innerduct run. The innerduct shall be a suitable fire rating for the installed environment.

D. Communications Manholes

1. Provide a 12’ service loop for each external cable that passes through a communications manhole. Dress the cable to keep it clear from any water that may be in the bottom of the manholes and to minimize any risk of damage caused by later visits to the manhole.

3.05 INSTALLATION PRACTICE

A. Provide bushings, grommets and strain-relief for cables terminating at wall-mounted outlets and patch panels to ensure durable and robust connections. The bushings and grommets are intended to protect the cables from any sharp edges that present a risk to the cables. Ensure that all sharp edges are covered to protect the cables from damage.

B. No cables shall be installed in a fashion that contravenes either the minimum installed or the minimum under-load bend radius of the cable.

C. No cable is to be pulled through a conduit “L-bend” (condulets). In existing routes with L-bends, the cables are to be pulled to the L-Bend. The cable is then to be carefully pulled through the remainder of the conduit run.

D. Install all cables in complete runs from outlet or patch panel to patch panel. In-line joints, splices, distribution points or other intermediate connections are not permitted unless specifically called out by this specification.

E. At no point shall the communications cables be tied to power cables or other building services or their supports, or run in the same ducts, raceways, conduits or connection boxes as power cabling.

F. Use plenum-rated Velcro tie wraps in plenum spaces.

G. Reinstate all pull-wires in conduits and ducts after use to facilitate future addition of cables.

H. Cables shall not be held so tightly with cable ties that the cable jackets are indented by the cable ties.

I. Ensure that all waste materials are disposed of in a safe manner. Pay particular attention to waste materials produced during the termination of optical fiber cabling. Ensure that all used components and fiber cut-offs are collected in purpose-made containers and disposed of properly.

J. Replace all moisture and fire barrier material in ducts, conduits and other penetrations disturbed during installation of communications cabling. Install barrier material in all fire-rated penetrations that have cabling running through them. The barrier material shall be installed so the final penetration has the same fire rating as the original wall/floor.

K. Use purpose-built pulling grips during cable installation. Do not pull cables by attaching pull wires to cable jackets, elements or reinforcement. Use strain gauges or equivalent measures to ensure that the maximum tensile load rating of the cables is not exceeded during installation.

L. Provide J-hooks and cable hangers as necessary to support cables running in the ceiling void. J-hooks shall be appropriately sized to allow a minimum of 50% spare capacity for future cable installation. J-hooks shall be at least 1" wide, and fitted at no more than 48" centers.

M. The number of cables in each conduit shall be controlled to allow for future cable installation and to stay within the manufacturers maximum allowable cable pulling tension. Conduit fill ratios shall not exceed the current requirements of the CEC.

N. The maximum run length of each horizontal cable shall not exceed the 90m (~295ft) limit specified by EIA/TIA 568-B.2. Notify the Owner's Representative immediately if, due to on-site conditions or other factors, a horizontal cable run length exceeds this distance.

O. Provide Velcro hook and loop ties to secure cabling running in the Telecom Closets. Provide straps at 3' intervals. On completion of installation, neatly run and re-tie all cable bundles in the Closet.

P. All cable bundles exiting floor or wall penetrations and running into furniture or casework shall be wrapped in spiral wrap or split-loom tubing to protect the cabling and provide a neat installation.

Q. Labels shall be machine generated, not hand-written, and placed within 12 inches of each end of each cable.

3.06 UNUSED COMPONENTS

A. Any components purchased in accordance with these specifications and unused shall be documented and passed to the owner on completion of the project.

3.07 TESTING

A. General Instructions.

1. The testing is to show beyond reasonable doubt that there are no errors, damaged or incorrectly installed components, that the installation is correctly labeled and that all the installed components meet or exceed the criteria detailed in these specifications. Any test that does not show that a component is satisfactorily installed, as per these specifications, shall be repeated. If a test procedure needs to be modified to satisfactorily test some components, the modification shall be submitted for approval of the Owner's Representative, prior to the tests being conducted.
2. Following optical fiber and data cable installation, including labeling and termination at both ends, undertake and record tests to ensure that the cabling system will perform satisfactorily in service. In addition to the tests detailed in this specification, the Installer shall carry out any additional tests that the Installer deems necessary to ensure the satisfactory operation of the telephone and data systems. The costs of these additional tests shall be borne by the Installer.

3. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to testing. Any testing performed on incomplete systems shall be redone on completion of the work.
4. Provide the Owners' Representative with the opportunity to witness all testing. On reasonable request, the installer shall demonstrate that the test procedure competently identifies the fault conditions being tested for.
5. Complete all of the tests identified in these specifications.
6. Notify the Owners' Representative ten working days before the date of commencement of the cable tests. Provide details in writing, on that advance date, of proposed tests, the test schedule, equipment to be used, its certification and calibration and the names and qualifications of test personnel.
7. The Owner and Owners Representative shall be invited, to the first instance of each type of test conducted. In the event of a number of tests being conducted by the Installer prior to this first inspection, the Owner's Representative reserves the right to reject these tests as non-compliant and to require them to be repeated at the Installer's cost.
8. The owner will reserve the right to request the use of the specific tester used by the contractor to conduct a random test of approximately 5% of the installed cables. If the measurement results differ appreciably (+/- 20%) from those of the contractor provided report than the sample will be expanded to 20% and be re-tested by the contractor under the observation of the customer. If the variances continue than the customer reserves the right to request a 100% re-test of the installation by a mutually agreeable third party, at the expense of the contractor.
9. Include the cost of obtaining, calibrating and maintaining test equipment and the cost of carrying out and recording the tests detailed in this specification, including labor costs, in the bid sum. No extra costs will be entertained.
10. Ensure that all test equipment is in calibration before delivery to site and throughout the testing period. The Installer shall be responsible for ensuring that any necessary tests and rework to maintain equipment's calibration status is carried out. Any tests performed on uncalibrated test equipment shall be repeated at the Installer's cost.
11. The test documentation shall be available for inspection by the Owners' Representative during the installation period and copies shall be passed to the Owners' Representative within five working days of completion of tests on cables in each area. The Installer shall retain a copy to aid preparation of as-built information.
12. Failures detected during the testing shall be noted on the test results schedule, rectified and re-tested. On the fault being rectified, this shall also be noted. These notes shall not be deleted or obliterated.
13. Rectification of all damaged cables shall include replacing damaged cables with new cables in complete runs, replacing damaged connectors or remaking poor terminations. In-line cable joints, splices or distribution points will not be acceptable except where specified in this document. All damaged cables shall be removed from site.
14. If on submittal of the As-Built documentation there are any missing test results or incorrectly named files, the test shall be repeated at the Installer's expense.

B. Category 6/6A Cabling

1. Test each Category 6/6A Cable and its associated connectors. Carry out the following tests on every pair of every Category 6/6A cable:

    a. Wire Map
    b. Length
    c. Insertion Loss
    d. NEXT Loss
    e. FEXT Loss
    f. ELFEXT

g. Propagation Delay and Delay Skew
h. Return Loss
i. Power Sum Near-End Crosstalk (PSNEXT) Loss
j. Power Sum Equal Level Far-End Crosstalk (PSELFEXT)

C. Work Area Faceplates and Blanking Plates

1. Carry out a visual inspection of the faceplates and blanking plates. Replace all damaged components.
2. Ensure that all faceplate labels are installed correctly.

D. Optical Fiber Cabling

1. Test each Optical Fiber Cable and its associated connectors. Carry out the following tests on every element of every optical fiber cable:

a. Length
b. End-to-End Attenuation
c. Connector Loss
d. Splice Loss
e. Power Loss

2. The tester shall have the following parameters:

a. Optical Time Domain Reflectometer (OTDR) shall be used to test every optical fiber cabling
b. OTDR shall be used to test optical in both directions and take the average. Provide a launch lead and far end drop off lead.
c. Singlemode optical fibers shall be tested at 1310nm and 1550nm

3. Test each optical fiber cable element and its associated connectors. Carry out the following test on every element of every optical fiber cable:

a. Visually check optical connectors using microscope (minimal magnification x200) to ensure that no physical damage has occurred during the installation process. There are to be no scratches on the core of the fiber or pits on the core or cladding. If any defect cannot be rectified with polishing, the connector is to be replaced.
b. Carry out OTDR tests on all elements at 1300nm wavelength for multimode cable runs and at 1310 nm for singlemode. These tests shall be carried out from both ends using a near end launch lead and a far end drop lead.
c. The number of samples (averages) for each OTDR test shall be such that the noise amplitude is significantly less than the smallest loss of any component under test. This may vary for different cable runs, for shorter runs and fusion splices etc.; it may be necessary to run many samples.
d. Record the length and loss of each mated connector pair on the test results schedule for all elements.
e. Verify the labeling of the cable and connectors is correct.
f. If a element has an excessive attenuation coefficient, a sudden step in attenuation coefficient (greater than 0.2 dB) or back scatter, losses due to micro bending or macro bending or has any other fault then the fault on that element shall be rectified.

g. The following table lists the pass/fail criteria for all connectors and fusion splices under test. Any component that does not pass these figures shall be re-worked or replaced.

Element Type	Maximum attenuation across mated connector pair (dB) – outward test	Maximum attenuation across mated connector pair (dB) – return test	Maximum Attenuation across fusion splice – averaged over both directions(dB)	Minimum Return Loss (dB) – outward test	Minimum Return Loss (dB) – return test
SM	**0.5**	**0.5**	**0.1**	**36dB**	**36dB**

h. The attenuation of each multimode connector shall be measured in one direction (outward). The attenuation of each singlemode connector shall be measured in both directions.

i. Each fusion splice shall be tested in both directions for both multimode and singlemode elements. The measurements for each direction shall be averaged for the final attenuation figure for each fusion splice.

j. The return loss must be measured in both directions for singlemode connectors. The return loss shall be greater or equal to the value shown in the table above.

k. Any failures shall be recorded (including value of excessively lossy terminations) and the results obtained after rectification of the fault shall be recorded.

l. Graphical printouts shall be taken of OTDR tests for each element. These printouts shall be stapled or otherwise attached to 11" x 8.5" size sheets. They shall be printed at an appropriate scale, such as 0.5 dB per division for the attenuation axis. Provide diskette copies of the OTDR traces to the owner on completion of the testing. Provide a copy of the emulation software and the appropriate license to the client.

END OF SECTION

SECTION 27 51 13

NETWORKED PAGING SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The General Conditions and Requirements, Special Provisions, of any larger body of specifications, of which this specification may be a part, are hereby made a part of this specification.

1.02 SUMMARY

A. This specification includes speakers, network audio components and cabling requirements for an IP based networked paging and announcement system.

1.03 REFERENCES

A. UL6500 - Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial and Similar General Use

B. UL1480 - Standard for Safety Speakers for Emergency, and Commercial and Professional Use

C. ASTM E 1374-02 - Standard Guide for Open Office Acoustics and Applicable ASTM Standards

D. ASTM E 1573-02 - Standard Test Method for Evaluating Masking Sound in Open Office Using a Weighted and One-Third Octave Band Sound Pressure Levels

E. ASTM E 1130-02e1 - Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index

F. Divisions 27 10 00 & 28 05 00 - Communications & Security Specifications

1.04 PERFORMANCE REQUIREMENTS

A. General Performance

1. The intent of this specification is to provide a hybrid IP and 70v classroom bell and paging system. Classrooms speakers must IP based and have the ability to control each and every speaker individually. Outside and common areas must be grouped together in a logical manor and homerun back to the MDF.

    a. Speakers located in classrooms must have the ability to be controlled individually
    b. Speakers located in common areas and outside must be grouped together in a logical manor

2. The entire classroom bell and paging system shall be controllable from a Microsoft Windows™ based computer
3. The basic system configuration shall provide multi-channel, coherent paging for networked speakers.

B. Paging Performance

1. The system shall accommodate equalization of all paging signals.
2. The paging volume shall be digitally adjustable in 0.5 dBA increments over a range of 35 dBA to 85 dBA @ 1m.
3. The paging processor shall be compliant with SingleWire Informacast™ systems to maintain communications continuity with the District deployed legacy notification system.

C. Automatic Level Control

1. The system shall provide a timer function allowing network audio levels to be automatically controlled according to a calendar-based user defined schedule.
2. The system shall provide automatic daylight-saving time adjustments.
3. The system shall allow independent timer multiple schedules for each day of the week.
4. The system shall allow configurable levels of volume adjustment and attenuation. The control processor shall be compliant with SingleWire InformaCast™ systems.

D. Network Performance

1. All network switches shall comply with MCCCD standards for Data Communications.
2. The system shall be capable of ensuring that the expected network devices are present and communicating properly and identify network devices that are not communicating properly.
3. The network control software shall be capable of monitoring and displaying the current settings for all network devices and speakers.
4. The system shall be capable of generating detailed reports of all system settings down to the level of individual network devices and speakers.
5. Speaker controllers shall be capable of equalization, level adjustment and network audio channel selection for every channel.
6. Speakers shall confirm to the following:

   a. Dynamic or Static IP Addressing
   b. IEEE802.3 10/100Base-T Ethernet
   c. IEEE 802.11AT Compliant
   d. VoIP Standard Audio: G.711 u-law/a-law (64 kbit/s) or G.722 Wideband Audio (64 kbit/s)
   e. Auto Provisioning: DHCP Option 66, 150, or TFTP Server or DHCP Option 72 for HTTP Server
   f. Auto Registration: SLP for InformaCast or DHCP Option 72 for SA-Announce or GCK

1.05 SUBMITTALS

A. Product Data: Manufacturer’s specifications, data sheets and installation instructions.

B. Network Design: Schematics of the network showing quantity and location of network components and related cabling.

C. Warranty Documents: Warranty documents covering the system components.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum of 10 years manufacturing paging systems.

B. Installer Qualifications: Approved by manufacturer representative and are trained with the specified products or have demonstrated experience with the installation of similar products.

C. Uses industry standard network switches and cabling and methodology following the Section 27 10 00 – Data Communications.

1.07 DELIVERY, STORAGE AND HANDLING

A. Protect from moisture during shipping, storage and handling.

B. Deliver in manufacturer's original unopened and undamaged packages with manufacturer's labels legible and intact.

C. Inspect manufacturer's packages upon receipt.

D. Protect from damage and theft during storage and staging until installation.

E. Handle packages carefully.

1.08 WARRANTY AND MAINTENANCE

A. Provide a written warranty that products installed shall be free from defects in parts or assembly for a 3-year period from date of installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Compliant with the Singlewire InformaCast™ system to maintain communications continuity with the District deployed legacy notification system.

B. Substitutions: Networked paging systems meeting the addressability criteria may be substituted. Systems utilizing primary and secondary network devices where the secondary device is not individually controllable are not acceptable. Systems having more than one speaker inside a classroom connected to a speaker channel are not acceptable.

C. The IP Paging System on campus is existing, and it is the intent for this project that the installed paging speakers for this building will tie into the existing paging system. Contractor shall

confirm with campus that the quantity of licenses required will be obtained to add speakers for this project.

1. Software and Licenses shall be Owner Supplied Contractor Installed and Programmed
2. Design Basis: Atlas Sound InformaCast
3. IP Loudspeaker (Wall Mounted in exterior locations) – The loudspeaker shall provide coverage of general areas as shown on the contract documents.
4. Design Basis: Atlas Sound
5. IP Loudspeaker (Exterior Walls) – The loudspeaker shall provide coverage of general exterior areas as shown on Contract documents.
6. Design Basis: Atlas Sound IP-HVP with flush in wall box IP-FEST-HVP
7. IP Speaker cabling shall conform to College Standard Cat 6 cable as described in 27 15 00

2.02 SYSTEM COMPONENTS

A. General System Overview: The paging system shall be a PoE networked system. The system shall be comprised of:

1. Microsoft Windows™-based computer running management software
2. VoIP phone or paging microphone
3. IP-to-Analog Controller and Mixer/Amplifier(s) as required for legacy equipment interface (existing building conditions only)
4. Loudspeaker assemblies
5. PoE network switch(es)
6. Cable assemblies
7. Dimensions: Width 19.0 inches Height 1.75 inches; 1 RU
8. Network communication components
9. Device shall be ETL listed to conform to UL60065

B. Each external wall and ceiling speaker assembly shall provide:

1. A networked connection to the speaker controller with strain relief
2. An acoustically damped vandal-resistant enclosure
3. Eye-bolt for single point suspension and upward facing speaker orientation
4. Speaker sensitivity: 90 dBA@1Watt, 1 meter pink noise
5. Speaker power rating: 10 watts RMS
6. Speaker frequency response: 100-10,000 Hz
7. Magnet size: 20 oz.
8. Device shall be ETL listed to conform to UL1480, UL2043, CSA C22.2 60065
9. Approved speaker manufacturers include Atlas IED, Valcom, Cisco, etc.

C. Each internal wall and ceiling speaker assembly shall provide:

1. A networked connection to the speaker controller with strain relief
2. An acoustically damped enclosure (plenum-rated as required) or A.C.T. suspended ceiling enclosure and speaker combined assembly
3. Eye-bolt for single point suspension and upward facing speaker orientation
4. Speaker sensitivity: 90 dBA@1Watt, 1 meter pink noise
5. Speaker power rating: 10 watts RMS

6. Speaker frequency response: 100-10,000 Hz
7. Magnet size: 20 oz.
8. Device shall be ETL listed to conform to UL1480, UL2043, CSA C22.2 60065
9. Approved speaker manufacturers include Atlas IED, Valcom, Cisco, etc.

D. Cable assemblies:

1. Provide power, audio and control signals over standard plenum rated CAT-6 with RJ-45 connectors.
2. For connection to new speakers, provide CAT-6 cable to each speaker home-run to closest telcom (BDF/IDF closet)
3. For connection to legacy speakers, provide speaker connections to speaker controllers with two conductors, 18 A.W.G. copper stranded, plenum rated wire.

2.03 SOFTWARE CONTROL

A. The software shall provide:

1. Operation on Microsoft Windows™ operating system
2. The ability to adjust any individual speaker without affecting adjacent speakers
3. The ability to define and adjust groups of speakers
4. Paging volume and equalization
5. The ability to route and mix network audio channels to any individual speaker
6. The ability to create and adjust zones for paging and music
7. Reporting of all system settings
8. Backup and restore functions for all system settings
9. Network diagnostics
10. Panic button integration
11. 911 Alerting
12. Building lockdown, evacuation & emergency notification
13. Pre-recorded announcements

B. In addition to the provided software, all system functions shall be able to monitored via SNMP (simple network management protocol) to facilitate integration into other network monitoring solutions.

PART 3 - EXECUTION

3.01 NETWORK DESIGN

A. Design network according to manufacturer's and MCCCD's Section 27 10 00 – Data Communications specifications.

3.02 SITE CONDITIONS

A. Verify facility conditions are suitable for the system installation.

B. Verify the facility is constructed according to plans including wall locations, ceiling types, plenum barriers and plenum heights.

C. Ensure sufficient space and power for centrally located components is available as per plan and manufacturer's specifications.

3.03 PERMITS

A. Obtain necessary permits for installation work.

3.04 INSTALLATION

A. Follow all applicable codes for the area.

B. Follow the system design for location of speaker controllers, speakers and wiring.

C. Record any necessary changes to the system design on the plan

D. Follow MCCCD's Division 27 10 00 – Data Communications

3.05 FIELD QUALITY CONTROL

A. Ensure that distance between the top of the loudspeaker and the deck meets manufacturer's minimum specifications

B. Ensure that loudspeakers are not obstructed

C. Ensure cables are properly supported and securely terminated

3.06 NETWORK CONFIGURATION AND ADJUSTMENT

A. Follow manufacturer's recommendations for system settings

3.07 TESTING AND REPORTING

A. Test covered areas for desired spectrum and spatial uniformity

B. Verify that all system audio functions and timers are correctly configured per plan

C. Provide data cable certifications per Section 27 10 00 – Data Communications

3.08 AS-BUILTS AND DOCUMENTATION

A. Provide detailed drawings showing all speaker controllers and speaker Identifications.

B. Provide a printed report detailing system settings.

C. Provide all instruction and installation documents in PDF format.

D. Provide all close-out and warranty information including product serial number listing. Data to be provided in editable spreadsheet table (Microsoft Excel™, etc.).

E. Provide a table of all networked components within the provided system documenting network IP address and information (device name, MAC address, connected network port number, etc.). Data to be provided in editable spreadsheet table (Microsoft Excel™, etc.).

F. Provide detailed documentation for speaker/channel levels and configuration.

END OF SECTION

SECTION 27 51 16

AUDIOVISUAL EQUIPMENT - MOUNTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: This Section specifies stationary ceiling mount and equipment enclosure and related accessories for ceiling installation of multimedia projectors.

1.02 ACTION SUBMITTALS

A. General: Submit listed submittals in accordance with Contract.

B. Product Data: Submit for specified products as follows:

1. Manufacturer's product data, including manufacturer=s technical data sheet(s).
2. Catalog pages illustrating products to be incorporated into project.

C. Shop Drawings: Indicate information on shop drawings as follows:

1. Layout indicating locations.
2. Dimensions.
3. Installation details.
4. Anchorage details.
5. Manufacturer’s recommendations for accessories and mounting kits.

1.03 INFORMATION SUBMITTALS

A. General: Submit listed submittals in accordance with Contract Conditions.

B. Manufacturer=s Instructions: Submit manufacturer’s installation instructions.

C. Source Quality Control: Submit documentation verifying that components and materials specified in this Section are from single manufacturer.

D. Mounting details per field conditions.

E. Quantity / type per room (including assigned room number).

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Submit operation and maintenance data for installed products.

B. Warranty Documentation: Submit warranty documents specified.

C. Keys for enclosure lock.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

   a. 5 years of experience manufacturing components similar to or exceeding requirements of project.
   b. Having sufficient capacity to produce and deliver required materials without causing delay in work.
   c. Capable of providing field service representation during construction.

2. Installer: Acceptable to manufacturer, experienced in performing work of this section and has specialized in installation of work similar to that required for this project.

1.06 DELIVERY, STORAGE & HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver material in accordance with project guidelines and in accordance with manufacturer=s written instructions.
2. Deliver materials in manufacturer=s original packaging with identification labels intact and in sizes to suit project.

B. Storage and Handling Requirements:

1. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.

C. Packaging Waste Management:

1. Separate waste materials for recycling.
2. Remove packaging materials from site and dispose of at appropriate recycling facilities.
3. Collect and separate cardboard for disposal for recycling.
4. Fold metal and plastic banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.01 CEILING PROJECTOR MOUNT

A. Description:

1. Mount shall be adjustable to accommodate multiple models of projectors of up to 75 lbs. in weight.
2. Compatibility:
   a. Ensure components and materials are compatible with specified accessories and adjacent materials. Mate all components to standard 1-1/2” NPT couplers and devices.

B. Model: Shall be Peerless CMJ450

C. Provide with 3” extension Column Chief CMS003

D. Confirm final model with College.

2.02 UNIVERSAL PROJECTOR MOUNT

A. Description:
1. Mount shall be adjustable to accommodate multiple models of projectors of up to 75 lbs. in weight.
2. Compatibility:
   a. Ensure components and materials are compatible with specified accessories and adjacent materials. Mate all components to standard 1-1/2" NPT couplers and devices.

B. Model: Shall be Premier Mounts model #PDS-PLUS-W or Peerless PRGSS.

C. Contractor to confirm with College on final mount.

D. Design/Performance Criteria:
1. Pitch: Plus, or minus 15 degrees.
2. Roll: Plus, or minus 20 degrees.
3. Swivel: 360 degrees.
4. Load Capacity: To 50 lb. (23 kg).

E. Operation:
1. Allows alignment of projector lens to the pivot axes.
2. Allows fine tuning of the image to the viewing screen.

F. Mounting:
1. Mounts to ceiling.
2. Include tamper resistant fasteners for projector and mount.

G. Materials:
1. Mount: Mild steel.
2. Grooved Coupling: 1 1/2 inch (38.1 mm) NPT steel half pipe.
3. U-Joint, Legs: 14 gauge formed steel.
4. Pitch Bracket, Locking Ring, Base Disk: 11 gauge steel.

H. Finish: Powder coated WHITE to match ceiling tiles.

2.03 PROJECTOR LOCK

A. Description:
1. Mount shall be adjustable to accommodate multiple models of projectors of up to 75 lbs. in weight.
2. Compatibility:
   a. Ensure components and materials are compatible with specified accessories and adjacent materials. Mate all components to standard 1-1/2" NPT couplers and devices.

B. Manufacturer: BMS

C. Model: Shall be BMS model #LCD LOC IV and shall be keyed alike according to College master key number. No exceptions allowed.

D. Finish: Powder coated WHITE to match ceiling tiles.

2.04 CEILING TV/MONITOR MOUNT

A. Description:
1. Ceiling Mount shall be adjustable to accommodate multiple models of flat panel monitors of up to 175 lbs. in weight.
2. Compatibility:
   a. Works with 37” to 85” diagonal monitors with standard VESA patterns (75x75, 100x100, 200x100 & 200mm x 200mm).

B. Manufacturer: Premier Mounts.
1. Contact: 130 E. Miraloma Avenue Anaheim, CA 92806 USA (800) 832-4888 / www.mounts.com
2. Single Source Responsibility: Provide like components and materials specified in this section from a single manufacturer.

C. Model: Shall be Premier Mounts model #ECM-3763S

2.05 ACCESSORIES

A. Extension Pipes and Couplers:
1. Model, Description: In conjunction with ceiling equipment box, use Premier Mount #PWH-10 as cable pathway and mounting extension and mate between ceiling box and universal mount. To be white in color to match with other mount components.
2. In locations where no ceiling equipment box is used or no drop ceiling grid occurs, use adjustable extension mount and pole to mate to above ceiling Uni-strut structure. Use Premier Mount #AST adjusting length so end of pole and universal projector mount extend below ceiling by 8”-12”.
3. As required to accommodate cabling to be passed through the box, pole and mount ultimately to the projector, a fish-mouth 1-1/2” NPT coupler shall be included. This can be part of included within the static or adjustable extension pole. Product to be Premier Mount #MSCC or appropriate model as required.

B. Accessories:
1. Include ceiling guy-wire attachment for four places per manufacturer instructions and project / Architect details. Use Premier Mounts #QLCS or approved equivalent using Uni-Strut members and pipe-clamp attachments from McMaster Carr.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer=s instructions prior to universal projector mount installation.
1. Inform Consultant of unacceptable conditions immediately upon discovery.
2. Proceed with installation only after unacceptable conditions have been remedied.

3.02 PREPARATION

A. Verify that mounting surface is capable of supporting a static load of four times the combined weight of the projector and the mount.

B. Remove projector mount assembly contents from carton and verify that there are no damaged or missing parts.

C. Surface Preparation: Prepare surface in accordance with manufacturer=s written recommendations.

3.03 INSTALLATION

A. Coordinate installation of universal projector mount in accordance with construction details, manufacturer's installation instructions and reviewed shop drawings at locations and heights indicated.

B. Coordinate universal projector mount work with work of other trades for proper time and sequence to avoid construction delays.

C. Install universal projector mount plumb and level to supporting substrate.

D. Replace non-secure screws with security screws.

E. Accurately fit, align, securely fasten and install free from distortion or defects.

3.04 ADJUSTING

A. Adjust components and systems for correct function and operation in accordance with manufacturer's written instructions.
   1. Verify that roll adjusts to plus or minus 20 degrees as designed and to meet project requirements.
   2. Verify that pitch adjusts to plus or minus 15 degrees as designed and to meet project requirements.
   3. Verify that mount operates with 360 degrees of swivel as designed and to meet project requirements

3.05 CLEANING

A. Upon completion, remove surplus materials, rubbish, tools and equipment.

B. Waste Management:
   1. Coordinate recycling of waste materials with section for Construction Waste Management and Disposal.
   2. Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.
   3. Remove recycling containers and bins from site.

3.06 PROTECTION

A. Protect installed product from damage during construction.

B. Repair damage to adjacent materials caused by universal projector mount installation.

END OF SECTION

SECTION 27 53 13 - CLOCK SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general conditions, Division 1, and Basic Electrical Requirements (Section 26 05 00) are part of this section and the contract for this work and apply to this section as fully as if repeated herein.

B. Reference to other sections: The applicable requirements from other Division 26 sections required for a complete and operational system shall form a part of the electrical work and each section shall be thoroughly reviewed by the Contractor for application to all other sections.

1.2 SUMMARY

A. Section Includes:
1. Wireless secondary indicating clocks.

B. Scope includes but is not limited to:
1. Provide (1) 5 watt transmitter, shelf and associated roof mounted antennas.
2. Provide (1) classroom clock in each classroom and associated 120V clock outlet and branch circuit as noted on the E and T drawings.

1.3 DEFINITIONS

A. NIST: The National Institute of Science and Technology.

B. UTC: Universal time coordinated. The precisely measured time at zero degrees longitude: a worldwide standard for time synchronization.

1.4 CODES,STANDARDSANDREFERENCES

A. ANSI/NFPA 70

B. California Electrical Code (CEC)

C. ANSI/IEEE Std. 1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

D. ASCE/SIE 7: Minimum Design Loads for Buildings and other Structures.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Master clock and housing 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."

1.6 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes (including available colors) for each product indicated and describe features and operating sequences, both automatic and manual, for the following:
   1. Wireless Indicating clocks.
   2. Accessory components.

B. Operation and Maintenance Data: For clock and program control to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC , by a independent qualified approved testing agency, and markeÖ for intended location and application.

B. Comply with CEC.

C. Installers: Shall be factory authorized and approved to installed specified equipment in San Diego County. Factory authorization shall be provided prior to start of Project.

PART 2 - PRODUCTS

2.1 MASTER AND SECONDARY CLOCK SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by the following to match existing:
   1. Innovation Wireless

2.2 SECONDARY INDICATING CLOCKS

A. Wireless Digital Clocks:
   1. Surface mounted 4-digit, 7-segment dimmable white LED display. Innovation Wireless #632402
   2. 120VAC powered with corÖ and plug.
   3. Clocks shall automatically update from the transmitter at regular intervals every day. System shall automatically adjust for Daylight Saving Time.
   4. Clocks shall keep operating in synchronized mode if the GPS signal is lost due to GPS failure. Once signal is re-acquired, clocks shall resume GPS time synchronization.
   5. Clocks shall keep operating as quartz based clocks for a minimum of 8 hours if there is a transmitter malfunction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide one clock per classroom or as noted per the E and T drawings.

B. Mount system components with fastening methods and devices designed to resist the seismic forces indicated.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Perform operational-system tests to verify compliance with the Specifications and make adjustments to bring system into compliance. Include operation of all modes of clock correction and all programming and manually programmed signal and relay operating functions.
   2. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

B. Clock system will be considered defective if it does not pass tests and inspections.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train District's maintenance personnel to adjust, operate, and maintain clock-and-program-control system components.

END OF SECTION

SECTION 28 05 00

SECURITY SYSTEM GENERAL REQUIREMENTS

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. MiraCosta 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 MiraCosta Building 400: 3333 Manchester Avenue, Cardiff, CA 92007

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 MiraCosta 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 EIDS Electronic Intrusion Detection System (EIDS) software programming, hardware devices, power supplies, and other components of the system as shown and specified.

1.6 SCOPE OF WORK

A. Systems: Provide an Electronic Access Control System (EACS) and Electric Intrusion Detection System (EIDS) with acceptable engineering and installation practices as described herein.

1. See drawings for existing doors to be reused. General Contractor (GC) to patch and paint existing doors. Security contractor to coordinate removal of existing non-electrified hardware with GC for patching of doors if required prior to painting. Security contractor to provide, install and terminate all new electrified door hardware. Reference section 28 13 00 and division 08 for door hardware types.

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 conditions. Where variations from the bid documents are required, such variations shall be approved by the Owner.

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 license required for all EACS and IDS installation, termination and testing of systems.
   b. C-28 license required for all electrified door hardware installation and termination and testing.
2. Hold current legally required state registrations required to meet local requirements for submittal drawings
3. Must provide letter documenting current status as Lenel/S2 certified dealer and installer. If Company is Greenfield exempt, Company shall list the Lenel/S2 Value Added Reseller

(VAR) that will supply, install, program and warranty the Lenel/S2 system. Project submittals must include copies of Lenel/S2 field technician certificates for all individuals that are working on campus EACS.

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 video recorders, EACS controllers, computer workstations, and application software.
3. Install conduit, cable, and new devices. Connect to controls, and test.
4. Install conduit, 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 MiraCosta 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 and Intrusion Detection Systems
   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.
6.	NFPA	National Fire Protection Association 101 Life Safety Code
7.	CCR Title 24	California Building Code
8.	CCR Title 24	California Electric Code
9.	ADA	Americans With Disabilities Act
10.	FCC	Part 15, Part 68
11.	IEEE	RS 170 variable 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 re-submittals.
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 dwg. format of the reviewed Record Drawings and three (3) copies of the reviewed Operating and Maintenance Manuals to the Owner, on CD or DVD disks.

1. 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. Off-Site Training

1. 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.
5. Power Relays: Provide American Electronic Components relays or equal by Potter & Brumfield.

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 California 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 – ***Global and local I/O,*** 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 28 05 00

SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Fire alarm wire and cable.
2. Identification products.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in CEC for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

E. RCDD: Registered Communications Distribution Designer.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of electronic safety and security cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.05 ACTION SUBMITTALS

A. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.01 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: 50 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC , by a qualified testing agency, and marked for intended location and application.

2.02 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with CEC , Article 760.

B. Network Communications: Multi-mode 50/125 OM2 fiber.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, CEC , Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

3. Multiconductor Armored Cable: CEC , Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.

2.03 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.01 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.02 WIRING METHOD

A. Install wiring in metal pathways and wireways.

1. Minimum conduit size shall be 3/4 inch. Control and data-transmission wiring shall not share conduits with other building wiring systems.
2. Comply with requirements in Section 260533 “Raceways and Boxes for Electrical Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

3.03 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 260533 “Raceways and Boxes for Electrical Systems."

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, CEC Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or pathway as signaling line circuits.
4. Use fiber media for network and audio riser communications.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.04 CONNECTIONS

A. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.05 FIRESTOPPING

A. Comply with TIA-569-C, "Firestopping" Annex A.

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.06 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 280553

IDENTIFICATION FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 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.

1.2 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 08 00, Security System Testing, and Commissioning

D. In accordance with Section 09 90 00, Paints and Coatings

1.5 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.

1.6 WARRANTY

A. In accordance with Section 28 05 00, Security System General Requirements

1.7 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 ¼" tape. Coordinate with Owner for exact location.

I. EACS Panel Relays: All relays on EACS panels shall be labeled with P-touch label ¼" tape, black lettering on a white label, identifying the MiraCosta College 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 ¼" 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 280700

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 Building 400 Greenhouse.

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 280800

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 Mira Costa Building 400 Greenhouse.

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 CEC, ANSI, IEEE, NFPA, NEMA and OSHA.

G. International Electrical Testing Association, Acceptance Testing Specifications (NETA ATS), latest edition.

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

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
    1) Doors with Door Position Switch (DPS) and Request to Exit device (REX) shall be tested for:
        a) Door Forced Open alarm is generated when door is opened from unsecured side
        b) Door Held Open alarm is generated when door is held open past its preprogrammed duration after valid REX event
        c) REX shunts alarm on egress
        d) REX does not shunt forced door alarm
    2) Doors with Electrified Exit Device, DPS and REX
        a) Door is locked in secure mode
        b) Door is unlocked by manual command from system workstation
        c) Door is unlocked by time zone
        d) Door Forced Open alarm is generated during secure mode only
        e) Door Held Open alarm is generated during secure mode only
        f) REX shunts alarm on egress during secure mode, for the preprogrammed duration
        g) Door relocks immediately when door closes after valid passage (does not wait for preprogrammed duration)
        h) REX does not unlock door
        i) REX does not bypass forced door alarm
        j) Door relocks on time zone
        k) Door relocks during day mode on manual command from system workstation
    3) Doors with Automatic door operators
        a) Door is locked in secure mode
        b) Door is unlocked by manual command from system workstation during secure mode
        c) Door is unlocked by time zone
        d) Door Forced Open alarm is generated during secure mode only
        e) Door Held Open to long alarm is generated during secure mode only
        f) REX shunts alarm on egress during secure mode
        g) REX does not unlock door
        h) Door relocks on time zone
        i) Door relocks during day mode on manual command from system workstation.
    4) Doors or Gates with card reader
        a) Door unlocks by use of the card reader for programmed unlock time and does not alarm when door is opened
        b) Door is locked in secure mode
        c) Door is unlocked by manual command from system workstation
        d) Door is unlocked by time zone
        e) Door Forced Open alarm is generated during secure mode
        f) Door Held Open alarm is generated during secure mode
        g) REX shunts alarm on egress during secure mode
        h) Door relocks immediately when door closes after valid passage (does not wait for preprogrammed duration)
        i) REX for door does not unlock door
        j) REX for gates does not unlock gate
        k) Door relocks on time zone
        l) Door relocks during day mode on manual command from system workstation

5) Doors with card and/or biometric iris and/or fingerprint reader
   a) Door unlocks by use of the card or iris reader for programmed unlock time and does not alarm when door is opened
   b) Door is locked in secure mode
   c) Door is unlocked by manual command from system workstation
   d) Door is unlocked by time zone
   e) Door Forced Open alarm is generated during secure mode
   f) Door Held Open alarm is generated during secure mode
   g) REX shunts alarm on egress during secure mode
   h) Door relocks immediately when door closes after valid passage (does not wait for preprogrammed duration)
   i) REX for door does not unlock door
   j) Door relocks on time zone
   k) 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 Contactor 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.

END OF SECTION

SECTION 281300

ELECTRONIC ACCESS CONTROL SYSTEM

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 the MiraCosta B400 Greenhouse.

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. Software includes required license addition for access control readers and electrified portals workstations.

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 Building 400. 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 MraCosta 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 and digital video recorders.
   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, 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 2 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. VSS Interface
z. 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 reader installed adjacent to IDS keypad installed outside Building 400.
2) First valid card read of the day from any exterior card reader deactivates the IDS system for the building.

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. 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, and 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, no acceptable.
c. Intrusion Card Readers
   1) Card readers utilized for arming and disarming of the intrusion system shall be connected to the access control system and provide output to the intrusion alarm panel to provide specified functionality
   2) Contractor is responsible for all wiring and equipment necessary between systems to have a complete and operational system.

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 (provide in Separate Enclosure)
      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 Life Safety Power FPO150/250 – 3D8P2M8NL4E4M1.
      2) Provide Von duprin PS906-2RS w/ 900- BB Power Supplies for QEL devices as required.

3) 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).
4) 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.
5) 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.
6) Transformers shall be installed in locked cabinets, protected by tamper switches. Plug-in transformers which are not protected by locked cabinets are not acceptable.
7) Power supply must include Low Power Disconnect (LPD) Module.

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 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.
4. Solid-state inputs and outputs.
5. 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.
6. Provide a Fire Alarm Interface Link to interface the LPS to the controller and Fire Alarm System, as required by code.
7. 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.

2.3 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 card reader: Windy City Wire P/N 004351, 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. Many of the doors in this project are existing and will be reused. Site verification and coordination with General Contractor
2. Doors shall not be locked in path of legal egress.
3. 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.
4. 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.
5. Owner approved electronic lock hardware (no substitutes permitted):
   a. L9092EU06LRXBD is approved standard mortise lock.
      1) SFM IC CORE required per exit device, confirm exact type and model with owner prior to order
   b. PA-QELRXSD98NLX990NLUS26D is approved electrified crash bar/exit hardware.
      1) 80-129 CYLINDER AND SFM IC CORE required per exit device, confirm exact type and model with owner prior to order
      2) The pad armor or “PA” designation shall prevent the catching of articles of clothing or other items on the panic device. The inclusion of this designation is a State of California Requirement.
   c. All lock hardware is to include integral request to exit (REX) switch.
   d. If there are any discrepancies between Section 08 71 00 and hardware specified herein, consult security design consultant for clarification.
6. Security contractor to provide and install required lock power supplies for all electrified door hardware. Coordinate AC power requirements with electrical contractor.
7. 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.
8. 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. Electric 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 mod
      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
o. Verify door can be manually opened during locked mode from secured side

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. Intrusion alarms
1. The Intrusion panel shall be configured to communicate to local authorities via Owner’s WAN. Coordinate connection with Owner.
2. This building has an existing Sonitrol intrusion system that must be completely removed, including all existing cabling, devices, power supplies and keypads.

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 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 integrate with EACS to arm the system via valid card read on separate, dedicated arming card reader. This is accomplished though hard-wired integration.

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.

B. Access Control Panel/Power Supply Enclosure
   1. Contractor shall provide proper wire management of reader boards attached to interior of door within the enclosure. Contractor shall ensure opening of the enclosure will not disrupt connections to boards.

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.

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) Testing of Lockdown Button
         2) Auto disarm by way of door reader
         3) Valid Card or Biometric Read (No Alarm)
         4) Electronic lock relock time (Door not opened)
         5) Door held open alarm time (Alarm)
         6) Forced door open (Alarm)
         7) Electronic lock relock on close (Closed within relock time)
         8) REX bypass Alarm on exit
         9) REX does not unlock door
         10) Valid card read during active REX
         11) 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

SECTION 28 31 11

DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Fire detection and alarm system.
2. Fire alarm control panel (FACP) compatible with the existing CAMPUS Fire Alarm Monitoring Station.

B. Related Sections:

1. Division 7 Section "Firestopping."
2. Division 23 Mechanical sections, for fan and smoke control.
3. Division 26 Electrical sections, for general electrical requirements, conductors, conduit and raceway.

1.02 DEFINITIONS

A. Whenever the term "system" is used herein without additional modification, it shall be taken to mean the fire detection and alarm system. The system shall be as defined in Section 204(c), Title 19, California Code of Regulations. It shall not be construed as including auxiliary circuits such as those associated with elevator recall, elevator machine electrical power disconnection, fan and smoke control system controls/devices, magnetic door hold-open release relays, and/or automatic-closing doors.

B. Unless otherwise specified, all system circuits (including, but not limited to initiating device, notification appliance, and relay circuits) shall be considered to start and end at the FACP.

1.03 PERFORMANCE REQUIREMENTS

A. The entire system shall conform to Titles 8, 19, and 24; California Code of Regulations, including all referenced standards. All equipment shall be UL Listed, FM-approved, and currently listed by the California State Fire Marshal.

B. At the minimum, include the following:

1. Provide an FACP and main fire alarm terminal cabinet (MFATC), as specified herein and as indicated on the drawings. Provide additional fire alarm terminal cabinets (FATCs), as

specified herein, in the additional locations specified herein and as indicated on the drawings.

2. Provide smoke, heat, and duct-mounted smoke detectors, and manual pull stations, as specified herein and as indicated on the drawings. Provide monitoring of all automatic fire sprinkler waterflow switches and control valve tamper switches. "Tampered cover option" switches shall be monitored separately from valve position or waterflow switches.
3. Provide audible/visual notification appliances and visual notification appliances, as specified herein, throughout the facility as indicated on the drawings and/or in accordance with ADA requirements.
4. Provide a visual annunciator with legend, as specified herein and as indicated on the drawings.
5. Provide a building location strobe light, as specified herein and as indicated on the drawings.
6. Provide a smoke detector to protect every fire alarm control unit (including, but not limited to: the main fire alarm control panel, every additional fire alarm control panel, every transponder panel, every auxiliary power supply, and every notification appliance power extender).

1.04 SUBMITTALS

A. Approval from the College's Representative and CALIFORNIA STATE Fire Marshal must be obtained for all components of the system submittal (including but not limited to: system contractor qualifications, material data sheets, and shop drawings). Submittals having any content which is incomplete or unclear will be returned without review or approval. If all components of the system submittal have not been approved due to Contractor's incompleteness or errors, the College shall have the right to require the Contractor to cancel the system contractor's contract and to engage the services of a substitute system contractor at Contractor's expense.

B. Submit catalog data sheets for all materials. Submit factory installation manuals/sheets for each component to be installed in the system. Data sheets/factory installation manuals/sheets are required for all system components, including but not limited to: control units, batteries, battery chargers, initiating devices, audible notification appliances, visual notification appliances, annunciators, terminals, cabinets, enclosures, conduit, wiring conductors, and relays. All equipment drawing alarm or supervisory current shall have documentation of the current draw highlighted in the submittal information. Submittals shall include State Fire Marshal Listing Sheets, including listing number with annual update and expiration date, for every system component. Submittals will be automatically rejected if complete listing information does not accompany submittal.

C. In addition, submit one original copy of the latest edition of the operation, maintenance, and installation manual(s) (whichever exist) for each FACP submitted. This is to be forwarded directly to the Fire Marshal.

D. Submit shop drawings.

E. After approval of the above materials submittal, submit installation shop drawings, prepared by a designer who has been factory-trained on the specified FACP. Working drawings shall be submitted in complete sets (partial submissions will not be accepted). Working drawings shall include, at a minimum:

1. Title sheet, which includes a sheet index, a scaled site plan, an initiating device signaling line circuit address list, a notification appliance circuit chart, a combination parts list/symbol legend, an annunciator zone schedule, and an annunciator legend (where applicable).
2. Standby power battery calculation(s).
3. Complete riser diagram.
4. Complete point-to-point wiring schematics.
5. Proposed conduit layout plan showing the actual routing of the conduit, the size and specific wires in each segment of conduit, the location of every device, module, and terminal cabinet (including identification of the initiating device/notification appliance circuit to which each is connected), the address of each addressable device, the location of all partitions, and the name and/or room number of each area or room. Where conduit will be installed within concealed spaces for which no access will be provided, the conduit routing layout must be scalable.
6. Interior elevations of each room where one or more FACPs, FATCs, battery cabinets/chargers, auxiliary power supplies and/or other control devices are located. Include details of manner of installation for any equipment weighing more than 20 pounds.
7. Voltage drop calculations for each notification appliance circuit. Calculations shall be based on 24 VDC, with high-level volume/level used for horns, and average current used for strobes.

F. Operation and Maintenance Manuals: Submit two (2) manuals, each of which shall include all instructions necessary for operation and required maintenance of the system, complete circuit diagrams, wiring and termination schedule for each circuit entering and on leaving each piece of equipment, schematic diagrams of each major component, including a replacement parts list with part numbers, name, and telephone number of local supplier. Include any portions of the material list and shop drawings which are not included in the foregoing.

G. Certification: Provide a Fire Alarm System Record of Completion as per Section 1-6.2.1, NFPA 72 (2016)

H. Record Drawings: Submit four sets of Record Drawings, which shall be sufficiently complete as to facilitate trouble shooting and repair of the system, as follows: one (1) set shall be black-line Mylar reproducibles, two (2) sets shall be blue-line (or equal) reproduction copies, and one (1) set shall be on an MS-DOS-formatted CD-ROM in AutoCAD, Release 14 (or higher) ".DWG" format with no "X-Refs". Final approvals are subject to receipt of acceptable Record Drawings. In particular, the Drawings shall identify every change of wiring/conduit direction accomplished by other than bending, including, but not limited to: junction boxes, pull boxes, "LB"s, "LL"s, "LR"s, entrance "L"s. Submittal of a single blueline (or equal) reproduction draft copy for review prior to the final submission is encouraged. Provide two copies of the MS-DOS-formatted CD-ROM containing the backed-up programming as required.

1.05 QUALITY ASSURANCE

A. Installer and Fabricator Qualifications:

1. The system contractor shall hold a current California C-10 contractor's license, and shall have held this license, under the currently-licensed business name, for a period of not less than five years as of the date of bidding the job.

    a. Submit evidence of the system contractor's current California C-10 contractor's license and list of minimum three comparable installations completed within the last five years.

2. The system contractor shall demonstrate satisfactory installations of comparable systems over a period of not less than five years immediately preceding the date of bidding this job, including references (name, email and telephone no.)
3. The system contractor shall be a factory-authorized distributor of the manufacturer of the specified FACP, and shall have been so continuously for a period of not less than five years as of the date of bidding the job. Additionally, the system contractor shall employ design personnel and installation technicians who have been factory-trained on the specified FACP.
4. The system contractor shall prove the ability to provide emergency restoration service within 12 hours by factory-certified personnel.
5. The system contractor shall be capable of providing drawings in AutoCAD, Release 14 (or higher), format.

B. The system specified herein and as described on the Drawings (including but not limited to materials, design, installation and testing) shall be provided by a single contractor, identified hereafter as the "system contractor," qualified as described below.

1.06 COORDINATION

A. The Contractor shall be specifically responsible for ensuring that no system components (including but not limited to: conduit, wire, terminal cabinets, junction boxes and/or device boxes) shall be installed prior to their having been detailed on approved shop drawings. The Contractor shall be specifically responsible for ensuring that coordination between the system work and the fire protection system work takes place to ensure full awareness of the location of all fire protection system components (including, but not limited to control valves, flow switches and tamper switches) requiring connection to the system. Further, the Contractor shall be specifically responsible for ensuring that coordination between the system work and other work takes place to ensure full awareness of the location of all components/devices requiring connection to the system (including, but not limited to: fan and smoke control system controls/devices, magnetic door hold-open release relays, and automatic-closing doors).

PART 2 - PRODUCTS

2.01 GENERAL SYSTEM REQUIREMENTS

A. The Contractor shall furnish and install a complete supervised microprocessor-controlled, intelligent reporting fire detection and alarm system consisting of one or more FACPs, FATCs, initiating devices, notification appliances, relay modules, FATCs, batteries and battery cabinets, annunciator panels, metallic conduit, boxes, wiring, and other components as required for a functional system.

2.02 MANUFACTURERS

A. Equipment shall be manufactured by Notifier (to match College standard). All major equipment (including, but not limited to initiating devices, notification appliances, and control elements) shall be the product of the manufacturer of the FACP.

1. Exception: Provide College's standard devices where specified or required.

2.03 FIRE ALARM CONTROL PANEL

A. The fire alarm control panel shall be manufactured by Notifier to match College standard, (Model: 320, 640, 3030 or NFC50/100 voice evac panel) capable of meeting the performance requirements herein. It shall contain a microprocessor based central processing unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, annunciators, and other system controlled devices.

B. Function: The main FACP shall perform the following functions:

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all initiating device, notification appliance, power, control, and signaling circuits throughout the facility by way of connection to monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
4. Visually and audibly annunciate any trouble, supervisory or alarm condition on operator's terminals, control panel display, and annunciators.
5. Code Generator: The FACP shall incorporate a solid-state audible signal code generator capable of generating the three-pulse temporal pattern (as defined in ANSI S3.41/ISO 8201) signal.

C. System Capacity and General Operation:

1. The FACP shall provide, or be capable of expansion, to not less than 127 intelligent/addressable devices per loop and not less than 254 annunciation points per system.
2. The FACP shall include a full featured operator interface control and annunciation unit that shall include a backlit, 80 character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the FACP.
4. The FACP shall be able to provide the following features:

    a. Block Acknowledge.
    b. Charger Rate Control.
    c. Control-By-Time.
    d. Automatic Day/Night Sensitivity Adjust.
    e. Device Blink Control.
    f. Drift Compensation.
    g. Pre-alarm Control Panel Indication.
    h. NFPA 72 Smoke Detector Sensitivity Test.
    i. System Status Reports.
    j. Alarm Verification, by device, with tall.
    k. Multiple Printer Interface.
    l. Multiple CRT Display Interface.
    m. Non-Alarm Module Reporting.
    n. Periodic Detector Test.
    o. Trouble Reminder.
    p. Upload/Download to PC Computer.
    q. Alarm Verification with Tally.
    r. Walk Test.
    s. Smoke Detector Maintenance Alert.

D. **Vo**ice Evacuation/Mass Notification Control Panel:

1. The Voice Evacuation/Mass Notification Control Panel shall be a NOTIFIER FirstCommand NFC-50/100 and shall contain a microprocessor-based Central Processing Unit (CPU). The CPU shall distribute and control emergency voice messages over the speaker circuits.
2. The system shall provide the capability to interface to LOC (Local Operator Console), Distributed Audio Amplifiers, Remote Page Unit, Remote Microphone, Fire Fighter Telephone Unit and Remote Telephone Zone Module from the same manufacturer.

3. Shall have as minimum requirements:

    a. Integral 50 Watt, 25 Vrms audio amplifier with optional converter for 70.7 volt systems. The system shall be capable of expansion to 100 watts total via the insertion of an additional 50-watt audio amplifier module (can be used as a backup amplifier) into the same cabinet. With the addition of optional circuit expander modules and remote Distributed Amplifiers the system can be expanded up to 24 speaker circuits and 1100 watts.
    b. Speaker circuit that can be wired both Class A and B.
    c. Integral Digital Message Generator with a memory capacity for up to 60 seconds per messaging. The Digital Message Generator shall be capable of producing fourteen distinct messages (60 seconds each). Field-selectable message and custom message recording capability using the local microphone, a USB port, or an external audio input.
    d. Built in alert tone patterns with ANSI, March Code, California, Steady, Alert Tone, Hi-Lo, ANSI Whoop, Continuous Whoop, or No Tone is field programmable. Tone Prior to transmitting a message, the Voice Evacuation/Mass Notification Control Panel can be programmed to produce a pre-announce and post-announce tone.

        1) Leading Tone Duration If a pre-announce tone is desired; select the length of time it will play before a message is broadcasted. Select 4, 8, 12, 16, 20, 24, or 28 seconds. In a pre-announce tone is not desired, select 0 seconds.
        2) Trailing Tone Duration Select the length of time for the post-message announcement tone. Select 4, 8, 12, 16, 20, 24, 28, or 32 seconds from the drop-down menu.
        3) Repeat Cycle Select the number of times the message will be repeated during an alarm. A message can be repeated 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, or an Infinite amount of times.

4. The Voice Evacuation/Mass Notification Control Panel will be capable of detecting and annunciating the following conditions: Loss of Power (AC and DC), System Trouble, Ground Fault, Alarm, Microphone Trouble, Message Generator Trouble, Tone Generator Trouble, and Amplifier Fault.
5. The Voice Evacuation/Mass Notification Control Panel shall be fully supervised including microphone, amplifier output, message generator, speaker wiring, and tone generation.
6. Speaker outputs shall be fully power-limited.
7. Amplifiers will be supplied power independently to eliminate a short on one circuit from affecting other circuits.
8. The Voice Evacuation/Mass Notification Control Panel will provide full supervision on both active (alarm or music) and standby conditions.
9. With the addition of an optional internal amplifier and a circuit expander module the main NFC-50/100 can be configured for up to 100 watts and 8 speaker circuits.
10. Optional distributed amplifiers shall be available to expand the system with up 24 speaker circuits up to 1100 watts.

11. Wiring terminals shall be removable terminal blocks (Wire Gauge 12 – 18 AWG) for ease of servicing.
12. Voice Evacuation/Mass Notification Control Panel will provide 2 amp Notification Appliance Circuit (NAC) output with sync generator or follower for System Sensor, Wheelock or Gentex protocols. The NAC shall be capable of One (1) Style Y (Class B) or Style Z (Class A) circuit.
13. Shall have eight Command Input Circuits to activate messages via reverse polarity or contact closures.
14. Built in External Audio Input can be used for background music.
15. On-board battery charger which supports charging up to 26 AH batteries (cabinet holds up to 18AH batteries).
16. Programmable delay of immediate, 2 hours or 6 hours reporting of AC Loss.
17. Built in Piezo sounder for local trouble.
18. Stores the events in the 100 Event History log.
19. Shall have Console Lamp Test switch and shall activate all system LEDs including Remote Consoles.
20. Shall have three Form-C relays:

    a. AC Power Loss Relay
    b. System Trouble Relay
    c. MNS Active (For Mass Notification signage)

21. Shall have a Special Application (auxiliary power) output for addressable modules when interfaced with compatible addressable FACPs and End-of-Line power supervision relays.
22. Shall be capable of Speaker Volume Control. The Supervised Volume Control will allow manual volume setting for telephone paging and background music for a specific speaker or speaker zone.
23. Shall have a Night Ring input allows a building's Private Branch Exchange (PBX) to activate the Voice Evacuation/Mass Notification panel.
24. The Voice Evacuation/Mass Notification panel can communicate in any combination up to eight (8) external remote consoles:

    a. Optional Remote Microphone
    b. Optional Remote Page Unit
    c. Optional Local Operator Console

26. The Voice Evacuation/Mass Notification panel can communicate in any combination up to eight (8) external distributed audio amplifiers:

    a. Optional Distributed Amplifier, 50 watts.
    b. Optional Distributed Amplifier, 125 watts.

27. Shall be capable of integrating with firefighter telephone system that provides secure and reliable communications. The firefighter telephone system will allow for up to ten users to plug in to a remote telephone jack and communicate simultaneously within a building.
28. Shall be capable of secure access to the Voice Evacuation/Mass Notification panel via cell phone or other remote telephone.
29. The Voice Evacuation/Mass Notification panel can be integrated by an FACP via the ANN/ACS (EIA-485) link. Compatible FACPs include the NFS-320, NFS2-640 and the NFW2-100 (FireWarden-100-2).
30. The Voice Evacuation/Mass Notification panel integrates with the NFS-320, NFS2-640 and the NFW2-100 (FireWarden-100-2) will report Mass Notification events to the Central Station.
31. The Voice Evacuation/Mass Notification panel can be interfaced with other UL Listed Fire Alarm Control Panels via activation of reverse polarity or by contact closure.

D. Speakers:

1. All speakers shall operate on 25 or 70 VRMS with field selectable output taps from 0.25 to 2.0 Watts.
2. Speakers in corridors and public spaces shall produce a minimum sound levels of 75 dBA output at 10 feet (3m).
3. The plug-in speaker allows the installer to pre-wire mounting plates and dress the wires before plugging in the speakers.
4. Flush mount applications are achievable without the need for an extension ring.
5. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
6. Rotary switch simplifies field selection of speaker voltage and power settings.

E. Enclosures:

1. The Voice Evacuation/Mass Notification panel shall be housed in a UL-listed cabinet suitable for surface mounting. The cabinet and front shall be corrosion protected and painted red via the powder coat method with manufacturer's standard finish.
2. The back box and door shall be constructed of steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall provide for the viewing of all indicators.

F. Central Processing Unit (CPU):

1. The CPU shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.
2. The CPU shall contain and execute all control-by-event (including AND-ing, OR-ing, NOT-ing, CROSSZONE-ing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.
3. The CPU shall provide a real-time clock for time annotation of all system displays. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

G. Display:

1. The system display shall provide all the controls and indicators used by the system operator and may be used to program all system operational parameters.
2. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
3. The system display shall provide an 80-character back-lit alphanumeric liquid crystal display (LCD). It shall provide light-emitting-diodes (LEDs) that will indicate the status of the following minimum system parameters: AC POWER, SYSTEM (FIRE) ALARM, and SYSTEM TROUBLE.
4. The system display shall provide a touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. A minimum of two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
5. The system display shall include the following minimum operator control switches: (ALARM) ACKNOWLEDGE, SIGNAL (ALARM) SILENCE, and (SYSTEM) RESET.

H. Signaling Line Circuit (SLC) Interface Board:

1. Each SLC board shall monitor and control a minimum of 127 intelligent addressable devices. This includes analog detectors (ionization, photoelectric, or thermal), monitor, and control modules.
2. The SLC interface board shall contain its own microprocessor, and shall be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the unlikely event of a failure in the main CPU of the control panel.
3. The SLC interface board shall not require any jumper cuts or address switch settings to initialize SLC operations.
4. The SLC interface board shall provide power and communicate with all intelligent addressable detectors and modules connected to its SLC on a single pair of wires. The SLC shall be capable of operation as NFPA Style 4 or Style 6, and capable of near-NFPA Style 7 operation using isolator modules.
5. Each SLC interface board shall be able to drive at least one Class A (NFPA Style 6) circuit capable of communicating with a device at least 2,500 feet from the FACP, and capable of communicating over a total of 10,000 feet of wire.
6. The SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

I. Serial Interface Board:

1. A serial interface board shall provide an EIA-232 interfaces between the FACP and the UL Listed electronic data processing (EDP) peripherals.
2. The serial interface board shall allow the use of multiple printers, CRT monitors, and other peripherals connected to the EIA-232 ports.
3. The serial interface board shall provide at least one EIA-485 port for the serial connection to annunciation and control subsystem components.
4. The serial interface board shall have LEDs that will show that it is in regular communication with the annunciators or other EIA 485 connected peripheral device.
5. EIA-232 serial output circuits shall be optically isolated to assure protection from earth ground.

J. Enclosures:

1. The FACP shall be housed in a UL Listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of minimum 0.060-inch steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).
4. The control panel shall be modular in structure for ease of installation, maintenance, and future expansion.

K. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

L. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL Standard 864.

M. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.

N. Main Power Supply (MPS):

1. The MPS shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
2. The MPS shall provide a minimum of 3.0 amps of usable notification appliance power, using a switching 24 VDC regulator.
3. The MPS shall be expandable for additional notification appliance power in minimum 3.0 amp increments.
4. The battery charger portion of the MPS shall be UL Listed as having the capacity to maintain the battery fully charged with automatic rate change.
5. The MPS shall provide a very low frequency sweep earth detect circuit, or an approved equivalent means, capable of detecting earth faults on sensitive addressable modules.
6. The MPS shall be power-limited using positive temperature coefficient resistors or an approved equivalent means.

    a. The above requirements apply equally to any supplementary and/or auxiliary power supplies determined necessary to fully power the system, as well as to the annunciator power supply.

O. System Circuit Supervision:

1. The FACP shall supervise all circuits to intelligent devices, annunciators and conventional peripherals and annunciate loss of communications with these devices. The CPU shall continuously scan the above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate that device or devices are not responding.
2. Sprinkler system control valves, standpipe control valves, post indicator valves, and main gate valves shall be supervised for off-normal position.

P. Field Wiring Terminal Blocks: For ease of service all wiring terminal blocks shall be the plug-in type and have sufficient capacity for 18 to 12 AWG wire. Terminal blocks permanently fixed are not acceptable.

Q. Municipal Tie Modules: A reverse-polarity module shall be provided for transfer of system alarm and trouble signals to the CAMPUS Fire Alarm Monitoring Station via campus fire alarm proprietary cable plant, with connection point at the main FATC. The contractor shall coordinate connection of this function with the College's Representative.

1. The normal polarity output current of the module shall be interrupted on all trouble (including supervisory) conditions, including loss of AC power, without reliance on batteries or other secondary power sources. The output polarity shall reverse on all alarm conditions and shall supersede any output current interruption due to trouble conditions. A remote station disconnect switch is required which, when operated, shall interrupt the output current irrespective of alarm conditions.

R. Field Programming:

1. The system shall be programmable, configurable and expandable in the field without the need for special tools or electronic equipment and shall not require field replacement of electronic integrated circuits.
2. All programming shall be accomplished either through the standard FACP keyboard or using DOS-based or Microsoft Windows-based software on a standard PC-compatible laptop computer.
3. All field-defined programs shall be stored in non-volatile memory.
4. The programming function shall be enabled with a password that may be defined specifically for the system when it is installed. A minimum of two levels of password protection shall be provided. One level shall be used for status level changes such as zone disable or manual on/off commands. A second (higher level) shall be used for actual change of program information.
5. System programming shall be "backed-up" on one or more MS-DOS formatted CD-ROMs. This system back-up shall be capable of download to a replacement FACP should the system be damaged due to fire or other event.

S. Specific System Operations:

1. Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification function shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification during the field programming of the system or anytime after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. System Point Operations:

    a. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad.
    b. System output points shall be capable of being turned on or off from the system keypad.

4. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

    a. Device Status.
    b. Device Type.
    c. Custom Device Label.
    d. Software Zone Label.
    e. Device Zone Assignments.
    f. Analog Detector Sensitivity.
    g. All Program Parameters.

5. System History Recording and Reporting: The FACP shall contain a history buffer that shall be capable of storing not less than 400 system output/input/control activations. Each of these activations shall be stored and time and date stamped with the actual time of the

activation, until an operator requests that the contents be either displayed. Contents of history buffer shall be manually reviewable, one event at a time, and the actual number of activations shall be capable of being displayed.

a. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable.

6. Automatic Detector Maintenance Alert: The FACP shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system shall enter the trouble mode, and the particular intelligent detector shall be annunciated on the system display. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80 percent of its alarm threshold.
9. Battery Charge/Transfer Module: Loss or brown-out of main power to the system shall automatically cause the system to transfer to battery power. Emergency power conditions shall be indicated by a lamp and audible annunciator. Upon return of system power, the control panel shall recharge batteries to full capacity within 48 hours following a discharge cycle as specified in 2.13 herein, and maintain battery on float charge thereafter. The charger shall be UL Listed as having the capacity to maintain the battery fully charged with automatic rate change.

2.04 MANUAL FIRE ALARM STATIONS

A. Manual fire alarm stations shall be rectangular, with a white "T" handle, the handle to pull out and down in an arc with a bottom pivot; single-pole single-throw gold-plated contacts with circuit connections via terminal block; operated stations to be readily distinguishable from front or side, reset to be accomplished with the College standard key. Stations must be designed so that after an actual activation, they cannot be restored to normal except by key reset. Manual stations shall be red with white-finished raised "FIRE ALARM" lettering, and shall be designed for semi-flush mounting, with the exception of the manual stations for use in locations requiring weatherproof devices, which shall be designed for surface mounting.

B. Manual stations shall be push double action type or lift and pull double action type.

2.05 SMOKE DETECTORS

A. Smoke detectors shall be intelligent addressable devices, and shall connect with two wires to an SLC.

1. Exception: Beam smoke detectors may be conventional devices, provided with monitoring modules and power supervision.

B. The detectors shall use the photoelectric (light-scattering) principle to measure smoke density and shall, on command from the control panel, send data to the control panel representing the analog level of smoke density.

C. The detectors shall be ceiling-mount and shall include a twist-lock base.

D. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

E. The detectors shall provide an address-setting means using decimal or binary (DIP) switches on the detector head or base. The detectors shall store an internal identifying code that the control panel shall use to identify the type of detector.

F. The detectors shall be provided with at least one alarm/power LED. The LED(s) shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. The LED(s) may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LED(s) shall be controlled through the system field program. An output connection shall be provided in the base to connect an external remote alarm LED. Remote alarm LEDs shall provide, in a unit capable of installation in a single-gang backbox, a remote visual indicator of alarm status of a connected detector.

G. The detector sensitivity shall be set through the FACP, adjustable in the field through the field programming of the system. Sensitivity may be automatically adjusted by the control panel on a time-of-day basis.

H. Using software in the FACP, the detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be UL Listed as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

I. The detector shall be available with bases with internal sounders, which, upon receipt of a command from, or supply of power from the FACP, shall generate a continuous audible alarm.

2.06 NOT USED

2.07 NOT USED

2.08 MONITOR MODULES

A. Each monitor module shall be capable of monitoring one supervised Style D (Class A) Initiating Device Circuit (IDC) consisting of one or more of conventional alarm initiating devices (any N.O. dry contact device).

B. Monitor modules shall have integral mounting brackets, and be capable of being mounted in a 5-inch square, 2.125-inch deep electrical box or surface-mounted backbox. Screw terminals shall be provided for connections to the SLC and the device(s) being monitored.

C. The monitor module shall provide address-setting means using decimal or binary (DIP) switches and shall store an internal identifying code that the FACP shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

D. For connection to shorting-type manual fire alarm stations, monitor modules shall be available in a miniature package capable of being installed within a single-gang box in conjunction with a manual pull station. This version does not require an LED.

2.09 CONTROL MODULES

A. Addressable control modules shall be capable of supervising and controlling the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized audible/visual notification appliances. In addition, for fan shutdown and other auxiliary control functions, the control module shall be capable of operating as a dry contact relay.

B. Control modules shall have integral mounting brackets, and be capable of being mounted in a 5-inch square, 2.125-inch deep electrical box or surface-mounted backbox. Screw terminals shall be provided for connections to the SLC and the device(s) being controlled.

C. Control modules shall be capable of being wired for a Style Z (Class A) NAC (up to 1 amp of inductive audible/visual notification appliance, or 2 amps of resistive audible/visual notification appliance) operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100 percent of all auxiliary relay or NACs are energized at the same time on the same pair of wires.

D. The control module shall provide address-setting means using decimal or binary (DIP) switches and shall store an internal identifying code that the FACP shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.

E. The control module shall incorporate a magnetic test switch to test the module without opening or shorting its NAC wiring.

2.10 ISOLATOR MODULES

A. Line-powered isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC. See 3.2.1.7 for required isolator module installation.

B. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section of the SLC. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

C. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

D. Isolator modules shall have integral mounting brackets, and be capable of being mounted in a 5-inch square, 2.125-inch deep electrical box or surface-mounted backbox. Screw terminals shall be provided for connections to the SLC and the device(s) being monitored.

2.11 NOTIFICATION APPLIANCES

A. Combination Audible/Visual Notification Appliances:

1. The audible portion of the combination audible/visual notification appliances shall be 24 VDC polarized, electronic horns. Rated reverberant output of the appliance shall be not less than 82 dBA at 10 feet when measured in accordance with UL 464 at nominal input voltage. Housings shall be white with red "FIRE" lettering.
2. The visual indicating portion of such combination appliances shall be 24 VDC polarized xenon tube stroboscopic devices, with minimum effective intensity not less than 15 candela per UL 1971 and a near-axis intensity of not less than 75 candela (light intensity not less than 117 candela per UL 1638 for exterior devices), light source color clear or nominal white, flash rate not less than 1 Hz nor more than 3 Hz, integrally mounted on the audible device.

These appliances shall be compatible with, and capable of being connected in a Style Z (Class A) synchronization scheme.

B. Visual-only notification appliances shall be 24 VDC polarized xenon tube stroboscopic devices, with minimum effective intensity not less than 15 candela per UL 1971 and a near-axis intensity of not less than 75 candela (light intensity not less than 117 candela per UL 1638 for exterior devices), light source color clear or nominal white, flash rate not less than 1 Hz nor more than 3 Hz, of the same manufacturer as the combination audible/visual notification appliances. These appliances shall be compatible with, and capable of being connected in a Style Z (Class A) synchronization scheme. Housings shall be white with red "FIRE" lettering.

C. Building location strobe lights shall be UL Listed for outdoor use, 24 VDC polarized devices, xenon tube, with red lens, flashing rate not to exceed 2 Hz. Light output shall be UL Listed for not less than 8.0 candela/seconds.

1. Location Lights: Amseco, Model SL-524R, or equal (no known equal).

2.12 VISUAL ANNUNCIATOR

A. The annunciator shall be exterior, weatherproof, tamperproof, with a hinged door. It shall be of one of the following two styles:

1. Red cottage style construction, with a keyed lock, provided with weatherproof "bullseye" annunciator indicating lamps and holders with clear or white lenses of not less than 0.6875 inches in diameter. Lamps shall be 24 or 28 VDC, 3.0 minimum spherical candlepower, 0.170 amp rated current, 250 hours minimum rated life, red-colored (No. 313R or equal). The annunciator shall have a lamp for each required zone (see 3.2.7) plus a minimum of 10 percent (but not less than four) spare indicating lights. Wiring shall terminate on terminal blocks. Where control panel zones are to be combined to a reduced number for the annunciator, provide diode matrix at FACP to accomplish. Exterior finish shall be suitable for coastal environment.
2. An analog display having a separate lamp or LED for each required zone (see 3.2.7) plus a minimum of 10 percent (but not less than four) spare lamps or LEDs, installed within a NEMA 4X enclosure provided with a window cover of sufficient size to permit observation of the entire display. The front of the enclosure shall either be hinged and provided with a lock keyed as per 2.15, hinged and secured with screws, or have a front entirely secured with screws. Remote annunciators which require operation of controls to see alarms on multiple zones are not acceptable.

B. Lamp power for the annunciator shall be supplied by separate power supply with FACP-monitored power-on supervision. This supply shall be independent of FACP ground-fault supervision. Power supply, including charging circuitry and batteries, shall meet the requirements specified for FACP power supplies.

C. Legends for annunciators as per 2.11.1.1 shall be permanently-engraved 0.125-inch minimum thickness plastic laminate–red in color with black lettering. Lettering shall be san-serif block style, all uppercase, 0.375-inch high minimum. Attach legends using double-sided tape with tamper-resistant screws at each corner.

1. During construction, the contractor shall ensure that the system supplier/designer coordinate requirements with the CALIFORNIA STATE Fire Marshal to provide a system fully-compliant with this specification.

2.13 FIRE ALARM TERMINAL CABINETS AND TERMINALS

A. The main fire alarm terminal cabinet shall have a minimum depth of 6 inches; all others shall have a minimum of 4-inch depth. All shall have full-face doors with integral, permanently-attached hinges and integral locks; have 0.75-inch deep fire retardant treated plywood (or integral formed steel) backboards; and be sized to allow neat wire and terminal installation. The main FATC shall be of such a size to leave a minimum clear backboard space 8 inches wide by 18 inches high at one side after installation of terminal strips, wiring, and any other devices/equipment.

1. Exception: Auxiliary FATCS (FATCS other than the main FATC or floor FATCS, containing modules and/or terminal blocks) in locations not readily accessible to the public (e.g., above ceilings, in locked electrical or mechanical rooms, above 8 feet a.f.f., etc.) Need only be provided with a positive means of latching.

B. Terminal blocks to be pressure plate box type, 300 volt medium duty, rated for No. 22 through No. 10 solid and stranded wire, polypropylene, dovetail base, tubular clamp, mounted on prepunched aluminum channel: Buchanan P0625 Terminals with P0630 end sections, No. 68 clamps, and No. 67 channel, or equal (no known equal).

2.14 BATTERIES

A. Batteries shall be rated for the capacity to operate the system in a full supervisory mode with AC power removed for 24 hours followed by operation of all notification appliances for 5 minutes. Batteries shall be lead-calcium, sealed, maintenance-free type.

1. The calculations done to determine the size batteries necessary to meet this requirement should be accomplished in accordance with the recommendations of the battery manufacturer with regard to the effects of applying a high-current load after a long period of low-current load. Regardless of the method used for the calculations, and/or the battery size(s) shown on approved shop drawings, the system contractor is responsible for providing batteries with the capacity required to successfully demonstrate compliance with this requirement.
2. The above requirements apply equally to any batteries associated with supplementary and/or auxiliary power supplies determined necessary to fully power the system, as well as to the annunciator power supply.

2.15 BATTERY CABINETS

A. Each battery cabinet shall be a separate, locking cabinet manufactured for the purpose.

2.16 CABINET LOCKS

A. Cabinet locks, including FACPs, battery cabinets, FATCs, and annunciators shall be keyed to the College standard.

1. Exception: auxiliary FATCS (FATCS other than the main FATC or floor FATCS, containing modules and/or terminal blocks) in locations not readily accessible to the public (e.g., above ceilings, in normally-locked electrical or mechanical rooms, above 8 feet a.f.f., etc.) need only be provided with a positive means of latching.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install equipment in compliance with manufacturer's written recommendations and installation instructions.

B. Locate and install conduit, devices, equipment, and accessories as specified. FACPs shall be located in approved electrical rooms.

1. Mount FACPs, FATCs, and any other control equipment such that terminals are located between 42 and 66 inches above the adjacent walking surface.
2. Center manual pull stations 48 inches above finished floor.
3. Install backboxes for all notification appliances with the bottom 80 inches above finished floor, or 10 inches below finished ceiling, whichever is lower.
4. Install backboxes for remote alarm LED/test stations and remote alarm LEDs with the bottom 80 inches above finished floor. Install on the strike side of the door of the room/space within which a smoke, heat, or duct smoke detector is located. If, for any reason, the remote alarm LED/test station cannot be mounted on the wall immediately adjacent to the door, provide a durable printed label on the remote alarm LED/test station identifying the room number of that room.
5. Install visual annunciators at a height of 54 to 60 inches from finished grade to bottom of housing, adjacent to fire access lanes, as shown on the drawings. If pedestal-mounted, provide an engraved legend firmly attached to the pedestal with tamper proof screws. Specific locations to be approved by the CALIFORNIA STATE Fire Marshal and the College's Representative.
6. The main FATC shall be located immediately adjacent to the FACP. The underground conduit for CAMPUS Fire Alarm Monitoring Station connection shall be extended to this cabinet.
7. There shall be no cabinets or equipment installed below a battery cabinet.
8. All conduit, devices, and equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Smoke detectors shall not be supported solely by suspended ceilings. Fasteners and supports shall be adequate to support the required load.
9. All equipment and devices installed in exterior or other locations exposed to the outside environment shall be approved and UL Listed for such application, or shall be installed in a NEMA 4X enclosure. All conduit, fittings and hardware shall be corrosion resistant rigid type.
10. All modules (e.g., monitor modules, control modules, signal modules, and isolator modules) shall be installed within an FATC, mounted in an appropriately-sized backbox.

    a. Exception: Miniature monitor modules may be installed within interior or weatherproof exterior manual fire alarm station backboxes.

11. Equipment installed in flammable or explosive atmospheres shall be approved and UL Listed for such application. All raceway and fittings shall be installed in accordance with the California Electrical Code for hazardous (classified) locations.
12. Provide a lockdown clip for each circuit breaker supplying power to system components. Circuit breakers shall be permanently and clearly identified at the circuit breaker panel by red marking and shall be identified as "FIRE ALARM CIRCUIT." Additionally, the location and designation of the circuit breaker panel, and the circuit breaker number(s) shall be permanently and clearly identified at the powered system component.
13. Door holders shall hold door open until smoke has been detected by the smoke detector(s) provided. When actuated, the device shall release door to close and shall release

automatically on power failure. Door holding devices shall NOT be connected to battery supply.

14. Building location strobe lights shall be located on the exterior of the building so as to be visible from the fire access lanes, as determined by the CALIFORNIA STATE Fire Marshal. They shall be securely mounted atop a section of rigid conduit so as to be 4 feet above the roof edge at the specified location, unless otherwise noted on the drawings or directed by the CALIFORNIA STATE Fire Marshal. They shall be powered by an independent notification appliance circuit and shall operate continuously when the FACP is in an alarm condition.
15. Penetrations of fire-rated construction shall be firestopped using an approved, listed through-penetration firestop system as specified in Division 7 Section "Firestopping."
16. Auxiliary power required by any device shall be 24 VDC, provided and supervised by the FACP in such a manner as to be identified separately from any other trouble condition.
17. FACP batteries shall be installed in battery cabinets as per 2.14.
18. Weatherproof manual stations shall be installed as surface-mounted devices, attached to the wall by screws through the pre-cast holes in the backbox only; no additional holes may be drilled. If entry into the box is from the rear, using the knockout provided, the foam gasket provided with the manual station must be used. Regardless of whether entry is through the top, bottom, or rear, it must be by conduit.

    a. Exception: when the rear knockout is used for entry, conduit may terminate at a single-gang outlet box, with the weatherproof backbox then installed using screws through the pre-cast holes. A knockout bushing is required.

C. System wiring shall conform to the following requirements:

1. All wire shall be new.
2. Minimum wire size shall be No. 12 AWG (No. 14 AWG permitted for IDC and NAC wiring not exceeding 25 VDC; No. 18 AWG permitted for SLC wiring), type THWN, 600 volt, solid copper. Wire size shall be increased as required to maintain voltage and current capacity. Voltage drop shall not exceed manufacturer's listing for NACs, but shall in no case exceed 10 percent.
3. Spare conductors shall be provided on a 10 percent (minimum two conductor) schedule per riser; annunciator panels shall be wired for full capacity, plus a minimum of six (6) spare conductors.
4. All system circuits (including, but not limited to initiating device, notification appliance, signaling line, power, and relay circuits) shall be run above-grade and/or overhead (i.e., there shall be no system circuit wiring in or below floor slabs).

    a. Exception: visual annunciator circuit wiring and post indicator valve tamper switch circuit wiring.

5. Wiring shall be continuous from FATCs to other FATCs, field devices and to the FACP. Splicing (whether in terminal boxes, junction boxes, device boxes, or below-grade) shall not be permitted. Parallel branches ("T" taps) are not permitted regardless of the method of supervision employed.

    a. Exception: devices available only with "pig-tail" connections shall be connected to the circuit wiring using approved insulated wire nuts.

6. Only those wires directly serving a duct detector shall be routed through its housing.

D. Terminal cabinets shall be provided and configured to conform to the following requirements:

1. All field wiring and FACP wiring shall be terminated in FATCs or on field devices.
2. There shall be at least one FATC for each floor (the main FATC may serve as the floor FATC for the floor on which it is located).
3. All system wiring shall be terminated in the main FATC. In addition, the wiring for each floor shall be terminated in that floor's FATC prior to entering and returning from the field.
4. All connections shall be made on terminals. There shall be one electrically independent terminal block segment for each conductor.
5. Circuit completions shall be accomplished with cross-connect jumper wires, 2 inches to 3 inches long, between pairs of vertically-oriented terminal blocks. All field device wiring shall terminate on the right-hand terminal strip; FACP wiring shall terminate on the left-hand terminal strip.

    a. Exception: in an FATC other than the main FATC or a floor FATC, the second terminal block and cross-connect jumpers may be omitted.

6. Terminal blocks shall be permanently identified with a sequential numbering scheme. All wires (with the exception of cross-connect jumpers) shall be identified with their corresponding terminal blocks with substantial markers.
7. There shall be 10 percent spare sets of terminals, minimum of 12 sets, installed in each main and floor FATC.
8. A minimum clear backboard space 8 inches wide by 18 inches high at one side shall be provided in the main FATC after installation of terminal strips, wiring, and any other devices/equipment.
9. All relays and other components carrying 120 VAC (e.g., for door holder circuits) shall be in separate FATCs from those containing the low-voltage system circuitry and/or components.

    a. Exception: such components may be installed within system FATCS if installed in separate enclosures labeled "caution--120 VAC" within them, with all 120 VAC wiring in conduit within the system FATC.

10. Terminal cabinets shall be hinged on the side farther from the FACP.

E. Conduit shall be provided and configured to conform to the following requirements:

1. All wiring shall be in metal conduit, concealed in interior locations, except that Schedule 40 PVC conduit shall be used underground. Minimum conduit size shall be 0.75-inch. EMT conduit shall be used in all above-ground locations, except that rigid steel conduit (PVC-coated where indicated below) shall be used in the following locations:

    a. Where required by code.
    b. In electrical, mechanical, and machine rooms.
    c. Where exposed to weather (PVC-coated).
    d. Where exposed and below 7 feet 6 inches above finished floor.

        1) Exception: Occupied or finished spaces.

    e. Where in slabs or in concrete (PVC-coated).
    f. Where exposed to physical damage.
    g. In corrosive areas (PVC-coated).
    h. In damp or wet locations (PVC-coated).

2. All system wiring shall be installed in conduit independent of all other electrical circuits.

3. All styles of Class A circuits (initiating device, signaling line, and notification appliance circuits) shall be wired without parallel branches, with return conductors separate (i.e., in separate conduit) from outgoing conductors, and are to start at and return to the main FATC. Conduit containing outgoing conductors shall be physically separated from conduit containing return conductors by not less than 12 inches horizontally; there is no separation requirement for vertical conduit.

    a. Conduit containing outgoing conductors and conduit containing return conductors separated by a wall of not less than one-hour fire-resistive construction may be spaced closer.
    b. Outgoing and return conductors may be routed through the same conduit for a distance of not more than 10 feet to an initiating device, notification appliance, or control panel enclosure.

4. Initiating device circuits and signaling line circuits shall be installed in separate conduit from notification appliance circuits. No circuit shall pass through a device mounting box, J-box, pull-box, or any other component of any other circuit.

    a. Exception: for risers connecting floor FATC's, initiating device circuits, signaling line circuits, and notification appliance circuits may be installed in the same conduit.

5. Maximum conduit fill shall be 75 percent of that permitted by the California Electrical Code.
6. All system conduit shall be red color. All junction box covers shall be externally identified by permanent red paint suitable for the purpose.

    a. Conduit containing auxiliary circuit wiring as defined in 1.2.2 are not to be so identified.

7. Magnetic door holding circuits and other non-power limited circuits shall be in separate raceway.
8. Exposed flexible conduit, as used for attachment to waterflow and valve tamper switches or similar applications, shall be liquid-tight and shall be the minimum length required for neat and secure installation. Flexible conduit lengths shall not exceed 3 feet. Flexible conduit shall not be buried nor located closer than 12 inches to grade.
9. Conduit shall be arranged such that only those wires directly serving a duct detector are routed through its housing.
10. Conduit shall not penetrate shaft walls nor be routed within shafts unless serving system components located within the shaft. Where a system component is located within a shaft, wiring to it shall be by means of a single conduit as permitted by Exception.

F. Signaling Line Circuits (SLCs) and initiating devices shall be installed to comply with NFPA 72 and the following requirements:

1. Smoke detector quantity and spacing shall be as recommended by the manufacturer and NFPA. Smoke detectors shall not be located in a direct airflow nor closer than 3 feet from an air supply diffuser.
2. Install manual stations in 4S deep boxes with single-gang rings whenever miniature monitor modules will be contained within the box.

    a. Exception: manual stations as per 2.3.3 shall be surface-mounted, with wiring entering the supplied backbox via conduit into the provided threaded knock-out only. The backbox shall be secured via screws through the through-holes provided; no additional penetrations of the backbox shall be made.

3. Provide wiring and connections to devices (such as, but not limited to: fire sprinkler waterflow switches, valve tamper switches, and waterflow alarm bells; duct smoke detectors; electrically-actuated smoke dampers; and roll-down fire door releasing devices) installed by other work.
4. Duct smoke detectors for closure of smoke/fire dampers shall be installed in accordance with manufacturer's installation instructions, within 5 feet of the smoke/fire damper, on the duct on the same side of the floor or wall as the smoke/fire damper actuator. Install duct detectors on the vertical sides of horizontal ducts only. Any required auxiliary power shall be 24 VDC provided and supervised by the FACP in such a manner as to be identified separately from any other trouble condition.

    a. Exception: with advance approval from the CALIFORNIA STATE Fire Marshal, duct smoke detectors may be installed on the duct on the opposite side of the wall or floor from the smoke/fire damper actuator.
5. Smoke or heat detectors located within concealed spaces (e.g., duct detectors located above the ceiling, in interstitial spaces, etc.) or in other areas not readily accessible (e.g., installed on roof-mounted air handling equipment, above 8 feet A.F.F., etc.) shall be provided with readily-accessible remote alarm LED/test stations located as per 3.1.1.4 in an approved location. Smoke or heat detectors located within rooms/spaces shall be provided with readily-visible remote alarm LED located as per 3.1.1.4 in an approved location.

    a. Remote alarm led/test stations connected to duct detectors for closure of smoke/fire dampers in corridor walls required to be of fire-resistive construction shall be installed in the corridor, regardless of which side of the wall the detector is actually located on.

6. Duct smoke detectors shall be installed in accordance with the manufacturer's written installation instructions, especially those portions having to do with required air differential pressure (see 3.6.12). Detectors failing the air pressure differential testing shall be relocated as necessary to permit passing the test.

G. Notification Alarm Circuits (NACs) and notification appliances shall be installed to comply with NFPA 72 and the following requirements:

1. The total of all audible/visual notification appliances on each circuit shall consume no more than 75 percent of the available output current of the notification appliance circuit module to which they are connected. The aggregate current demand of all audible/visual notification appliances shall not exceed 75 percent of the system power supply available for audible/visual devices.
2. Provide notification appliances in electrical and mechanical equipment rooms.
3. The System Contractor shall determine the number and location of audible notification appliances necessary to meet the audibility requirements which shall be included in the submittals. Any audible notification appliances shown on the drawings shall be considered as sample locations only and shall be supplemented as required to meet audibility requirements. Tests shall be made to prove that audible notification appliances meet these requirements; additional audible notification appliances required as a result of this test shall be provided and installed without cost to the College.
4. Audible notification appliances shall be selected and located to provide a minimum sound level of 15 dBA above ambient in all areas and shall be rated for a minimum of 82 dBA at 10 feet on axis with a maximum of 100 dBA. There shall be audible notification appliance installed on each floor within each apartment unit and in similar dwelling units.
5. Audible notification appliances shall be semi-flush mounted in accordance with their listing.
6. Every audible notification appliance shall be provided with a visual notification appliance mounted on the audible notification appliance housing. In addition, there shall be a visual notification appliance installed in every sleeping room.

7. The visual notification appliances shown on the drawings shall be considered as sample locations only and shall be supplemented to meet requirements of NFPA 72, 1999, as amended by Part 2, Title 24, California Code of Regulations. If additional visual notification appliances are required to meet these requirements, they shall be provided and installed without cost to the College.
8. An addressable control module shall be provided to supervise and control the operation of each auxiliary notification appliance power supply used in the system.
9. Audible/visual notification appliance power shall be provided by a separate supervised power loop from the main FACP or from a supervised, UL Listed remote power supply.

3.02 GENERAL SYSTEM OPERATION

A. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto a Style 6 (Class A) signaling line circuit equipped with isolator modules as specified herein.
2. Initiation device circuits shall be Style D (Class A).
3. Notification appliance circuits shall be Style Z (Class A).
4. Digitized electronic signals shall employ check digits or multiple polling.
5. A single ground or open on the signaling line circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
6. Alarm signals arriving at the FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
7. The system shall be zoned, by use of isolator modules, in accordance with the following:

    a. By building.
    b. By floor.
    c. By wing or fire area.
    d. At both ends of every underground circuit.
    e. There shall be a minimum of 10 percent spare capacity for additional devices between each pair of isolators/isolation modules.

8. Resetting of all devices shall be a single operation accomplished at the FACP.
9. Silencing of an alarm shall not prevent subsequent initiating devices from initiating and indicating an alarm in a non-interfering manner.

    a. During construction, the contractor shall ensure that the system supplier/designer coordinate requirements with the CALIFORNIA STATE Fire Marshal to provide a system fully-compliant with this specification.

10. The fire alarm contractor is responsible for tying in the owner provided analog gateway controller to the audio input of the voice evac fire alarm system. The fire alarm contractor is responsible for complete programming of the voice evac fire alarm system in order to make the system go hot when the relay output is triggered. Coordinate with College IT during installation and have them sign off when complete.

B. The system shall be installed and wired with all necessary equipment, wiring, conduit, and hardware to perform all designated functions. Activation of any alarm initiating device shall result in, as a minimum, the following:

1. The System (Fire) Alarm LED shall flash.
2. A local piezo-electric signal in the control panel shall sound.

3. The 80-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. Activate all notification appliances throughout the building. In buildings so equipped, activate all voice alarm systems as per 3.2.11. Unless otherwise approved in advance by the CALIFORNIA STATE Fire Marshal, all audible notification appliances and all visual notification appliances throughout the building shall be synchronized.
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 (notification appliances and/or relays) shall be activated.
6. Cause annunciation by zone at the visual annunciator.
7. Transmit an alarm condition to the CAMPUS Fire Alarm Monitoring Station.
8. Continue the alarm condition until manually reset.
9. Release all door holders in the building.
10. Operate building location strobe/annunciator lights (provided with non-coded power) until manually reset (not silenceable).
11. All alarms originating from smoke detectors (including duct detectors) shall undergo alarm verification (maximum delay: 60 seconds) prior to initiating a general alarm condition.

C. Activation of any system trouble or supervisory condition shall be indicated audibly and visually at the FACP and shall transmit a trouble signal to the CAMPUS Fire Alarm Monitoring Station.

D. Activation of a duct smoke detector for closure of a smoke/fire damper shall initiate the closure of the associated damper, as well as initiating an alarm at the FACP.

E. The visual annunciator shall provide visual indication of an alarm condition of, at a minimum, the following initiating devices:

1. Manual Stations: By floor, wing and fire zone.
2. Smoke and Heat Detectors: By floor, wing, and fire zone.
3. Duct Smoke Detectors: By floor, wing, and fire zone.
4. Sprinkler Waterflow: By floor, wing, and fire zone.
5. Special System Monitoring: By system (e.g., Halon, Inergen, dry chemical, carbon dioxide).

F. Operation of the SIGNAL (ALARM) SILENCE switch at the FACP shall deactivate all notification appliances (both audible and visual, except for the building location strobe light[s]). Activation of any other alarm initiating device shall cause them to be reactivated.

G. Activation of a smoke or heat detector with an associated remote alarm LED shall result in illumination of the alarm LED.

3.03 IDENTIFICATION

A. Provide identification of equipment and materials.

3.04 GROUNDING

A. All metallic conduit, cabinets, junction boxes, and exposed non-current-carrying metal parts shall be permanently grounded. A separate No. 10 AWG conductor shall connect a grounding bus bar located in the main FATC to building ground. The bus bar shall be provided with a minimum of five tubular, pressure type screw terminals sized for No. 18 AWG through No. 10 AWG wire. The ground wire for the FACP and the main FATC shall be grounded via the bus bar.

3.05 DOCUMENTATION

A. Copies of complete as-built installation wiring documentation, internal FACP schematics, and maintenance manuals are to be submitted prior to final acceptance.

3.06 SYSTEM ACCEPTANCE TESTING

A. Prior to acceptance testing of the system, it shall be tested and adjusted by the contractor under the supervision of a factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

B. When the system is complete and operating normally in all respects, the Contractor shall furnish necessary equipment and personnel to perform acceptance testing, as described herein. Acceptance testing shall be accomplished in the presence of the CALIFORNIA STATE Fire Marshal and the Owner's Representative, and at the direction of the CALIFORNIA STATE Fire Marshal. The purpose of the testing is to ensure that all equipment and devices are installed in an approved manner and are performing as specified. Any deficiencies found must be rectified and the system retested.

1. The system contractor shall provide not less than two persons, at least one of whom shall have been personally involved in the installation of the system, and at least one of whom shall have been personally involved in the programming/start-up of the system. In addition, the system contractor shall provide not less than three units of two-way communication equipment capable of communicating between any two points within the building. Finally, the system contractor shall have available for, and to be retained by the CALIFORNIA STATE Fire Marshal a preliminary set of as-built drawings, and at least one copy of the operation manual for the FACP.

C. Testing will include, but not be limited to, the following:

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Close each sprinkler system control valve and verify proper supervisory alarm at the FACP.
3. Verify activation of all flow switches.
4. Open initiating device circuits and verify that the trouble signal actuates.
5. Open and short signaling line circuits and verify that the trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground all circuits and verify response of trouble signals.
8. Check presence and audibility of all notification appliances.
9. Check installation, supervision, and operation of all intelligent smoke detectors.
10. Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
11. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, alarm verification functionality and similar.
12. With the air handling unit turned on, and all filters and dampers in place, measure the air differential pressure on all duct smoke detectors which use sampling tubes.
13. Verify zones annunciated on the visual annunciator agree with the initiating zone.

14. When any defects are detected, make repairs or install replacement components, and repeat the tests as required.
15. When all other tests have been completed to the satisfaction of the College's Representative, the system shall be continuously operated on battery power for a period not less than 24 hours, immediately followed by a period not less than 5 minutes during which all notification appliances shall operate continuously. The test shall be considered to have been successfully accomplished if all notification appliances operate as specified throughout the 5-minute period.

3.07 DEMONSTRATION AND TRAINING

A. The Contractor shall provide the services of a system manufacturer's trained and authorized engineer/technician for providing instruction and training to College's personnel in the operation, maintenance and repair of the complete system. The instruction and training shall be held at the College's premises or at an authorized training facility in two sessions of 8 hours each, and shall be provided at no additional cost to the College. "Hands-on" demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. A typewritten "Sequence of Operation" shall be provided.

END OF SECTION

SECTION 311000
SITE CLEARING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Removal of existing debris.

1.2 RELATED REQUIREMENTS

A. Section 015639 - Tree and Plant Protection

B. Section 017419 – Construction Waste Management and Disposal

C. Section 033000 - Cast-in-Place Concrete

D. Section 312200 - Grading: Topsoil removal.

E. Section 312316 – Excavation

F. Section 312323 - Fill: Fill material for filling voids and excavations generated as a result of site clearing and demolition operations.

G. Section 321313 – Concrete Paving

H. Section 321316 - Decorative Concrete Paving

I. Section 328400 – Landscape Irrigation

J. Section 329313 – Lawns and Grasses

K. Section 329316 – Exterior Plants

L. Section 334111 – Storm Drainage Utility Piping

1.3 REFERENCE STANDARDS

A. Standard Specifications for Public Works Construction (“Green Book”), current edition

B. San Diego Regional Standard Drawings, 2018 edition.

1.4 SUBMITTALS

A. Water Pollution Control Best Management Practices: As required by contract documents and permit conditions.

B. Site Plan indicating:

1. Vegetation removal limits.

2. Areas for temporary construction laydown/storage, field offices and contractor parking.

1.5 QUALITY ASSURANCE

A. Clearing and Site Demolition: Work must be performed by a Contractor experienced in the type of work required and with the proper equipment.

B. Perform Work in accordance with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill Material: Furnish and place fill material as approved by geotechnical engineer.

PART 3 - EXECUTION

3.1 SITE CLEARING

A. Providing construction surveying to establish limits of site demolition.

B. Install water pollution control and dust control measures as first order of work. Inspect, maintain, and repair water pollution control and dust control measures during construction in accordance with drawings until permanent vegetation has been established.

C. Minimize dust generation due to clearing operations through watering or other approved measures.

3.2 EXISTING UTILITIES AND BUILT ELEMENTS

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Request and coordinate DigAlert for public/franchise utility markout. Provide private markout service for private utilities not covered by DigAlert and perform potholing to confirm locations of existing utilities.

C. Protect existing utilities to remain from damage and avoid interrupting existing utility services.

D. Clearly mark and protect existing structures, utilities and other elements that are not to be removed.

3.3 VEGETATION

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds as indicated in drawings.

B. Do not begin clearing until vegetation to be relocated has been removed.

C. Do not remove or damage vegetation beyond the limits indicated on drawings.

D. Install orange construction fence at least 3 feet high to prevent inadvertent damage to MiraCosta College vegetation to remain:

1. At vegetation removal limits.

2. Around trees and other vegetation to remain within vegetation removal limits; locate no closer to tree than at the drip line.

E. In areas where vegetation must be removed but no construction will occur other than previous paving, remove vegetation with minimum disturbance of the subsoil.

F. Vegetation Removed: Do not burn, bury, or leave removed vegetation on site.

1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.

2. Trees: Remove stumps and roots to depth of 24 inches.

3. Existing Stumps: Remove stumps and roots to depth of 24 inches.

4. Fill holes left by removal of stumps and roots, using approved fill material, with top surface neat in appearance and matching existing grade.

G. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.

H. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.4 DEBRIS

A. Recycle construction waste in accordance with construction waste management requirements.

B. Remove debris, deleterious material and trash from site.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 312200
GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal and storage of topsoil.

B. Rough grading the site for site structures and building pads.

C. Replacement of topsoil and finish grading.

1.2 RELATED REQUIREMENTS

A. Section 015639 - Tree and Plant Protection

B. Section 017419 – Construction Waste Management and Disposal

C. Section 311000 - Site Clearing

D. Section 312316 – Excavation

E. Section 312323 - Fill

F. Section 321313 – Concrete Paving

G. Section 321316 - Decorative Concrete Paving

1.3 PRICE AND PAYMENT PROCEDURES

A. Earthwork:

1. Measurement Method: By the cubic yard, in place.

2. Includes, but not limited to: Excavating existing topsoil, stockpiling and placing where required and compacting.

1.3 REFERENCE STANDARDS

A. Standard Specifications for Public Works Construction (“Green Book”), current edition

B. San Diego Regional Standard Drawings, 2018 Edition.

1.5 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

A. Grading: Work must be performed by a Contractor experienced in the type of work required and with the proper equipment.

B. A certified geotechnical engineer must be provided by the Contractor and be present for supervision of all grading operations.

C. Perform Work in accordance with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Topsoil excavated on-site.

1. Graded.

2. Free of roots, rocks or clumps larger than 4 inches, subsoil, debris and deleterious material.

B. Other Fill Materials: See Section 312323.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated in field.

3.2 PREPARATION

A. Perform construction surveying to locate required lines, elevations, and datum.

B. Stake and flag locations of known utilities. Pothole to verify locations.

C. Locate, identify, and protect from damage overhead and underground utilities to remain.

D. Notify utility company(ies) in advance to remove and/or relocate existing utilities.

E. Protect site features to remain, including but not limited to, bench marks, existing structures, fences, sidewalks, utilities, paving, and curbs from damage by construction operations.

F. Protect trees to remain by providing temporary construction fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.

G. Protect plants and other features to remain as part of final landscaping.

3.3 ROUGH GRADING

A. Remove and stockpile topsoil as indicated.

B. Remove and dispose of unsuitable soils as directed by geotechnical engineer.

C. See Section 31 23 23 for filling procedures.

D. Benching Slopes: Horizontally bench existing slopes greater than 1:4 as directed by geotechnical engineer.

E. Remedial Grading: Remove and recompact soils and perform other remedial grading as directed by geotechnical engineer.

F. Excavate material and place fill to line and grade as indicated.

3.4 SOIL REMOVAL AND STOCKPILING

A. Stockpile excavated topsoil on site, and re-use as indicated.

B. Remove excess from site.

C. Stockpiles: Use areas designated on site; pile depth not to exceed 6 feet; protect from erosion by covering with plastic sheeting.

3.5 FINISH GRADING

A. Before Finish Grading:

1. Verify building and trench backfilling have been inspected.

2. Verify pavement subgrade has been contoured and compacted to 95% R.C.

B. Remove debris, roots, branches, stones, in excess of 4 inches in size. Remove soil contaminated with petroleum products.

C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 12 inches.

D. Place topsoil in areas indicated.

E. Place topsoil where required to level finish grade.

F. Remove roots, weeds, rocks, and foreign material while spreading.

G. Near buildings spread topsoil manually to prevent damage.

H. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

I. Lightly compact placed topsoil.

J. Slope grade away from building minimum 2%, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

3.2 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.10 foot from required elevation.

B. Top Surfaces of Pavements: Shall match required elevations shown on drawings.

3.3 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds.

C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.4 FIELD QUALITY CONTROL

A. See Section 312323 for compaction density testing.

3.5 CLEANING

A. Remove unused stockpiled topsoil. Grade stockpile area to prevent standing water.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 312316
EXCAVATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Excavation for rough grading operations.

1.2 RELATED REQUIREMENTS

A. Section 312200 - Grading

B. Section 312323 – Fill

1.3 REFERENCE STANDARDS

A. Standard Specifications for Public Works Construction (“Green Book”), current edition

B. San Diego Regional Standards Drawings, 2018 edition.

1.4 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

A. Excavation: Work must be performed by a Contractor experienced in the type of work required and with the proper equipment.

B. A certified geotechnical engineer must be provided by the Contractor and be present for supervision of all grading operations.

C. Perform Work in accordance with Standard Specifications for Public Works Construction, current edition.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

3.2 EXCAVATING

A. Excavate to accommodate new structures and construction operations.

B. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

D. Do not interfere with 45 degree influence line of foundations.

E. Cut utility trenches wide enough to allow inspection of installed utilities.

F. Hand trim excavations. Remove loose matter.

G. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.

H. Slope grade away from building minimum 2%, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

I. Grade top perimeter of excavation to prevent surface water from draining into excavation.

J. Remove excavated material that is unsuitable for re-use from site.

K. Remove excess excavated material from site.

END OF SECTION

SECTION 312323
FILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fill for rough grading operations.

1.2 RELATED REQUIREMENTS

A. Section 312200 - Grading

B. Section 312316 – Excavation

1.3 REFERENCE STANDARDS

A. Standard Specifications for Public Works Construction (“Green Book”), current edition

B. San Diego Regional Standards Drawings, 2018 edition.

1.4 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

A. Fill: Work must be performed by a Contractor experienced in the type of work required and with the proper equipment.

B. A certified geotechnical engineer must be provided by the Contractor and be present for supervision of all grading operations.

C. Perform Work in accordance with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

A. Materials for compact fill may include any soil excavated from cut areas at the project site with an Expansion Index of 50 or less. Compacted fill shall contain no rocks or hard lumps greater than 6 inches in maximum dimension and shall contain at least 30 percent of material smaller than 3/4 inch in size. Material of perishable, spongy, or otherwise improper nature shall not be used in fills. Asphalt concrete pieces shall not be used in fill. Imported fill soils should consist of a granular material with less than 35 percent passing the No. 200 sieve based on ASTM C136, and an Expansion Index less than 20 based on ASTM D4829

PART 3 - EXECUTION

3.1 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

3.2 PREPARATION

A. Scarify subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with approved fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.3 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Slope grade away from building minimum 2%, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

F. Correct areas that are over-excavated.

1. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 percent of maximum dry density.

G. Compaction Density Unless Otherwise Specified or Indicated: 90% min., 95% in upper 12 inches of pavement subgrades.

H. Reshape and re-compact fills subjected to vehicular traffic.

3.4 FIELD QUALITY CONTROL

A. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").

B. If tests indicate work does not meet specified requirements, remove work, replace and retest.

END OF SECTION

SECTION 331313
PORTLAND CEMENT CONCRETE PAVING

PART 1 – GENERAL

1.1 SUMMARY

A. Related documents:

1. Drawings and general provisions of the contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this section.

B. Section includes:

1. Concrete curbs, gutters, sidewalks and concrete paving for roadways, bus bays and parking areas.

C. Related Sections:

1. Section 015639 – Tree and Plant Protection

2. Section 017419 – Construction Waste Management and Disposal

3. Section 033000 - Cast-in-Place Concrete

4. Section 311000 – Site Clearing

5. Section 312200 - Grading

6. Section 312316 – Excavation

7. Section 312323 - Fill

8. Section 321316 - Decorative Concrete Paving

9. Section 328400 – Landscape Irrigation

10. Section 329313 – Lawns and Grasses

11. Section 329316 – Exterior Plants

12. Section 334111 – Storm Drainage Utility Piping

1.2 REFERENCES

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2009).

B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).

C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2015.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.

G. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.

H. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.

I. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

J. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types); 2004 (Reapproved 2013).

K. Standard Specifications for Public Works Construction (SSPWC or “Green Book”), current edition.

L. San Diego Regional Standard Drawings, 2018 edition.

M. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; current edition.

N. California Building Code, Title 24, Part 2, Volume 1 Chapter 11B; current edition.

1.3 SUBMITTALS

A. Product Data: Provide data on concrete mix design, joint filler, admixtures and curing compound.

B. Samples: Submit two sample panels, 48 x 48 inch in size illustrating each finish.

C. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

1.4 QUALITY ASSURANCE

A. Qualifications of Workers: Provide sufficient skilled workers and supervisors who shall be present at all times during execution of this work and who shall be thoroughly familiar with the type of construction involved and the materials and technique specified.

B. Standard: Provide base as indicated, concrete curbs/paving and installation complying with Standard Specifications for Public Works Construction.

C. Obtain materials specified in this section from the same sources throughout the Work.

D. Maintain one copy of the Drawings and Specifications on site.

E. Work shall conform to the requirements of the California Air Resources Board (CARB) and local Air Quality Management District.

F. Perform Work in accordance with Standard Specifications for Public Works Construction, current edition.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not place concrete when temperature is less than 40 deg. F.

2. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.1 PAVING ASSEMBLIES

A. Comply with applicable requirements of Standard Specifications for Public Works Construction.

B. Concrete Sidewalks: 2,500 psi at 28 days concrete, 4 inches thick minimum, gray color Portland cement, finish as indicated.

2.2 FORM MATERIALS

A. Form Materials: As specified in SSPWC.

B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751).

1. Thickness: 1/2 inch.

2.3 REINFORCEMENT

A. Reinforcing Steel and Welded Wire Reinforcement: Types specified in SSPWC.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) yield strength; deformed billet steel bars, unfinished.

C. Dowels: ASTM A615/A615M, Grade 60 - 60,000 psi yield strength; deformed billet steel bars, unfinished.

2.4 CONCRETE MATERIALS

A. Obtain cementitious materials from same source throughout.

B. Concrete Materials: Provide in accordance with Standard Specifications for Public Works Construction standards.

C. Cement: ASTM C150/C150M Normal - Type I Portland type.

1. Please note soil corrosivity is not known.

D. Fine and Coarse Mix Aggregates: ASTM C33/C33M.

E. Fly Ash: ASTM C618, Class C or F.

F. Calcined Pozzolan: ASTM C618, Class N.

G. Silica Fume: ACI 211.1

H. Water: Clean, and not detrimental to concrete.

I. Air-Entraining Admixtures: ASTM C260/C260M.

J. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing.

1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.5 ACCESSORIES

A. Curing Compound: ASTM C309, Type 1, Class A.

B. Tactile Warning Surfaces: In compliance with ADA standards.

2.6 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of compressive strength, as specified in ACI 301.

1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.

D. Concrete Properties:

1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 2,500 psi; As indicated on drawings.

2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.

3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.

4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.

5. Cement Content: Minimum 520 lb. per cubic yard.

6. Water-Cement Ratio: Maximum 40 percent by weight.

7. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.

8. Maximum Slump: 4 inches.

9. Maximum Aggregate Size: 3/4 inch.

2.7 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.2 SUBBASE

A. Prepare subbase in accordance with SSPWC standards.

3.3 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Cover or coat surfaces of manholes, catch basins, and other structures frames with oil to prevent bond with concrete pavement.

3.4 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

A. Place reinforcement at mid-height of slabs-on-grade.

B. Place reinforcement as indicated.

C. Interrupt reinforcement at expansion joints.

D. Place dowels to achieve pavement and curb alignment as detailed.

E. Provide doweled joints 24 inches on center at transverse joints.

3.6 COLD AND HOT WEATHER CONCRETING

A. Follow recommendations of ACI 305R when concreting during hot weather.

B. Follow recommendations of ACI 306R when concreting during cold weather.

C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet.

3.7 PLACING CONCRETE

A. Place concrete in accordance with SSPWC standards.

B. Do not place concrete when base surface is wet.

C. Place concrete using the slip form technique.

D. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

E. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

F. For decorative top cast, follow Section 32 13 16 Decorative Concrete.

G. Floor and ground surfaces shall be stable, firm, and slip resistant and shall comply with CBC Section 11B-302 and 11B-403.

3.8 JOINTS

A. Align curb, gutter, and sidewalk joints. Apply joints to form square panels of concrete. Follow joint layouts as provided in the drawings.

B. Place 1/2 inch wide expansion joints at 30 foot intervals and to separate paving from vertical surfaces and other components.

1. Form joints with joint filler extending from bottom of pavement to within 1/4 inch of finished surface.

2. Secure to resist movement by wet concrete.

C. Provide sawcut joints.

1. At 5 feet intervals maximum.

2. Between sidewalks and curbs.

3. Between curbs and pavement.

3.9 ENHANCED FINISHES

A. Per details indicated in plans and specifications.

B. Apply sealer as indicated.

3.10 FINISHING

A. Sidewalk Paving: Light broom, texture perpendicular to direction of travel. Floor and ground surfaces shall be stable, firm, and slip resistant and shall comply with CBC Section 11B-302 and 11B-403.

B. Curbs and Gutters: Light broom, texture parallel to pavement direction.

C. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.11 TOLERANCES

A. Top Surfaces of Pavements: Shall match required elevations shown on drawings.

3.12 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

1. Provide free access to concrete operations at project site and cooperate with appointed firm.

2. Submit proposed mix design of each class of concrete to Architect testing firm for review prior to commencement of concrete operations.

3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards of each class of concrete placed.

1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

2. Perform one slump test for each set of test cylinders taken.

C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.13 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Do not permit vehicular traffic over pavement.

END OF SECTION

Section 321316

DECORATIVE CONCRETE PAVEMENT

PART 1.0 - GENERAL

1.1 SUMMARY

A. Section Includes: Furnishing of services, labor, materials, transportation, tools and equipment necessary to perform the work indicated on the Drawings and specified herein as required to properly complete the work in this contract.

B. This Section includes the following:

1. Landscape Site Concrete Paving

Related Sections include the following: List below only products and construction that the reader might expect to find in this Section but are specified elsewhere.

1. 01 56 39 Tree and Plant Protection
2. 03 30 00 Cast-in-place Concrete
3. 31 10 00 Site Clearing
4. 31 22 00 Grading
5. 31 23 16 Excavation
6. 31 23 23 Fill: Compacted Subbase for Paving
7. 32 13 13 Concrete Paving
8. 32 84 00 Landscape Irrigation
9. 32 93 13 Lawns and Grasses
10. 32 93 16 Exterior Plants
11. 33 41 11 Storm Utility Drainage Piping

1.2 REFERENCES

A. Conform to the following codes and standards:

1. American Institute (ACI)
2. American Society" for Testing and Materials (ASTM): The specifications and standards hereinafter referred.
3. Standard Specifications for Public Works Construction 2000

1.3 DEFINITIONS

A. Definition in this Article refers to those materials that make up cementitious component of water-cementitious materials ratio.

B. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: Furnish manufacturer's product specifications and installation instructions for the following and for each type of product indicated.

1. Form release agent
2. Plastic dowel sleeves
3. Curing agents
4. Clear sealer
5. Expansion joint filler material
6. Fiber reinforcement
7. Joint sealant
8. Finish retardant

B. Products; Submit one-pound samples, clearly identified, for each component used to prepare each paving type, including but not limited to:

1. Aggregate

C. Design Mixtures: Furnish certified reports of proposed mix design for each type of concrete installation. For each decorative cement concrete pavement mixture, include alternate mixture designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

D. Paving Mix Designs: Provide documentation for each paving type specified on Drawings that will enable College's Authorized Representative's to better match replaced concrete:

E. Laboratory and Cement Test Reports: Submit six (6) copies of laboratory test reports for concrete materials and a certificate with each concrete mixer truck, stating mix design, PSI, rating, slump, water and cement quantity, cement/water ration, fine and coarse aggregate and color additives.

1. Cement:
    a. Manufacturer and plant location
    b. Cement type, i.e. I, II, III, or V.
2. Admixtures:
    a. Manufacturer and plant location.

3. Sand:

    a. Source and Type.

4. Aggregates:

    a. Source and Type.

5. Signed certification from a licensed structural engineer.

F. Qualification Data:

1. For Installer:

    a. Provide evidence to indicate successful experience in providing decorative concrete work similar to that specified herein and can demonstrate successful experience through past Project documentation and references.

    b. Experience: Minimum 5 years' experience in the installation of patterned concrete paving.

    c. Demonstration of Experience: 10 Projects which have been completed within the past 36 months utilizing similar products, scope and complexity.

    d. Supervision: Perform placement and finishing of concrete work under supervision of a person having a minimum of 5 years of experience in placement and finishing of products specified herein.

2. Submit qualifications to College's Authorized Representative for information purposes. Submit a resume of Project Manager and Superintendent who will be overseeing the Work.

G. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

2. Material Certificates: For the following materials, signed by manufacturers:

    a. Cementitious materials.

    b. Steel reinforcement and reinforcement accessories.

    c. Fiber reinforcement.

    d. Admixtures.

    e. Curing compounds.

    f. Applied finish materials.

    g. Bonding agent or epoxy adhesive.

h. Joint fillers.

3. Field quality-control test reports.

4. Minutes of pre-installation conference.

5. Delivery slips.

H. Certification that College's Authorized Representative's sample panels have been reviewed and that materials and processes provided will achieve intended effects indicated on College's Authorized Representative's sample panel.

I. Submittals for above items shall be made in one package. If submittals are judged incomplete or non-responsive to the directions of the College's Representative after three (3) submissions the Contractor shall be back charged for the College's Representatives costs to process additional Submittals. Additional Submittal Procedures are specified in Section 01300.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative cement concrete pavement systems.

B. Pre-Bid Conference: Prior to submitting bid, attend pre-bid conference with College's Authorized Representative to review College's Authorized Representative's production run quality samples of all specified concrete colors and finishes and to review requirements and artistic effect desired.

C. Slip Resistance: Provide a finish surface slip resistance coefficient of friction equal or greater than 0.6 for flat surfaces and 0.8 for ramps, when tested in accordance with ASTM F 489.

D. Ready-Mix-Concrete Producer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Producer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

E. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

F. Source Limitations: Obtain decorative cement concrete pavement products and each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate through one source.

G. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

I. Referee Panels: The College's Representative will provide production run quality samples of all specified concrete paving colors and finishes to be used as Referee Panels to judge the Field

Mock-ups. The College's Representative will provide information and assist the Contractor on the mix design components used to achieve the Referee Panels.

J. Mockups: Cast mockups of sections approximately 48-inches by 48-inches of decorative cement concrete pavement to demonstrate typical pattern, texture, surface finish, color, joints, and standard of workmanship.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by College's Representative. Include joints and joint materials, caulking, scoring treatments, and finishes specified on the plans.

2. If multiple finishes are specified, all samples shall be prepared for review at the same time.

3. In presence of College's Representative, damage part of the exposed surface of decorative cement concrete pavement for each finish and texture required, and demonstrate materials and techniques proposed for repair to match adjacent undamaged surfaces.

4. The Mock-ups shall be reviewed and approved by the College's Representative before proceeding with the work. Mock-ups will be judged against the appearance of the Referee Panels. Mock-ups that do not match the Referee Panels and do not demonstrate all specified joints and joint materials, caulking, scoring treatments, and finishes will be rejected. Remove and reconstruct the mock-ups until approved. The Contractor shall be back charged for the costs of the College's Representative to review more than two (2) mock-up attempts. Approved mock-ups shall serve as standard of acceptance for paving work and remain available for the duration of the project.

5. Demolish and remove mock-ups at the completion of the project.

K. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings" and Quality Control."

1. Before submitting design mixtures, review decorative cement concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and decorative cement concrete pavement construction practices. Require representatives of each entity directly concerned with decorative cement concrete pavement to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixes.

c. Ready-mix concrete producer.

d. Decorative cement concrete pavement Installer.

2. Manufacturer's representative of decorative cement concrete pavement system.

L. Formwork: Comply with Recommended Practice for Concrete Formwork, ACI 347.

1. Qualifications: Refer to Section 01400 Quality Requirements.

1.6 DELIVERY AND HANDLING

A. Conform to Section 01600 Product Requirements.

B. Deliver, store, and handle reinforcement to prevent damage.

1.7 REGULATORY REQUIREMENTS

A. Testing: Slump tests shall be taken to certify compliance with mix design.

B. Mix design shall be in accordance with ACI 211-6. with ASTM C 143.

C. Conform to applicable laws, codes, and regulations required by authorities having jurisdiction over the work.

1.8 SITE CONDITIONS

A. Do not place concrete when subbase surface temperature is less than 40 degrees F, nor when surface is wet.

19 COORDINATION

A. In accordance with Section 01315, ensure that irrigation sleeves, electrical conduit, and other utility elements are accommodated and as-built located prior to pouring concrete.

1.10 INSPECTION OF SITE

A. Verify conditions at site affect Work of this Section and take field measurements as requires. Report major discrepancies between Drawings and field dimensions to College's Authorized Representative prior to commencing work.

PART 2.0 - PRODUCTS

2.1 PRODUCTS

A. Forms, reinforcement, concrete materials, and admixtures shall be per Section 32 13 13 Portland Cement Concrete Paving.

2.2 CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per square yard, complying with AASHTO M 182, Class 2.

B. Moisture-Retaining Cover: One of the following complying with ASTM C 171:

1. Waterproofing paper.

2. Polyethylene film.

3. White burlap-polyethylene sheeting.

C. Evaporation retarder below temporarily reduces moisture loss from concrete surfaces awaiting finishing in hot, dry, and windy conditions. Evaporation retarders are neither curing compounds nor chemical surface retarders used to delay concrete setting.

D. Surface Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

a. Top Cast/Top Face by Grace Products

b. Rugasol

i. Waterbased Clear siloxane or silane penetrating sealer. Acceptable products include, but not limited to:

c. “Pentane”

d. “Weather Worker J-26 WB” or equal. (No known equal).

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, specifically manufactured for use with colored concrete.

1. Products:

a. Anti-Hydro Company; Clear Cure Water Base

b. The Burke Company; Spartan Cote WB

c. Cormix Construction Chemicals; Sealco VOC

2.3 JOINT MATERIALS

A. Expansion- and Isolation-Joint Materials: -Filler Strips: Premoulded material, ½-3/8” thick, depth as required by slab, of resilient, non-bituminous material, depth as required by slab.

2.4 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. 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 requirements, and as follows:

2.5 PAVING TYPES

A. Concrete Paving Type 1: Standard Grey Concrete with Topcast #5 broom / sand finish.

B. Concrete Paving Type 1, Finish 2: Standard Grey Concrete with Topcast #50 – medium finish; handseeded shell aggregate ½” to 3/8” size

C. Concrete Paving Type 1, Finish 3: Standard Grey Concrete with Topcast #75 – rough finish; handseeded shell aggregate ½” to 3/8” size

PART 3.0 - EXECUTION

3.1 EXAMINATION

A. Examination, preparation, and placement of concrete and joints shall be per section 32 13 13 Portland Cement Concrete Paving.

3.2 CONCRETE FINISHING

A. General: Paving finishes to match approved mock-up finishes.

B. After placing concrete, tamp with heavy grille tamper until at least 3/8" of mortar has been brought to the surface. As soon as the surface becomes workable, push down coarse aggregate, filling all holes and leveling surface to a true and even surface.

C. Finish paving to match approved mock-up and have a uniform color and texture over the entire area.

1. Surfaces shall be free of ruts, grooves, dimples.

2. Edges shall be crisp and true to lines, and have finishes consistent with the field area. Float surfaces to required surfaces and planes. Finish to etch surface so that fines are exposed (no aggregate exposed.)

3. Ensure that paving surfaces receiving the finish are hand-troweled before final concrete set.

4. Match approved paving sample. It is recommended that a 2-foot x 2-foot test sample be poured from the same field mix and finished as same for each finish specified.

   Sand or Buff Wash Finishes:

5. Light:

   a. Light finish paving to match approved mock-up.

   b. Thoroughly clean field pour and allow to dry.

   c. Check for “hard spots”.

   d. Follow steps as outlined above for a light finish.

6. Heavy

   a. Heavy finish paving to match approved mock-up.

   b. Thoroughly clean field pour and allow to dry.

   c. Check for “hard spots”.

   d. Follow steps as outlined above for a light finish.

7. Exposed Aggregate:

    a. Exposed aggregate finish paving to match approved mock-up and have a uniform color and texture over the entire area.

    b. Surfaces shall be free of ruts, grooves, dimples.

    c. Edges shall be crisp and true to lines, and have finishes consistent with the field area. Float surfaces to required surfaces and planes. Finish to etch surface so that fines are exposed (no aggregate exposed.)

    d. Immediately after concrete has been screeded and darbied, apply specified surface aggregate (if specified in the Drawings), evenly over entire surface, allowing no voids in coverage.

    e. After seeding aggregate, embed the aggregate by hand-floating, so that top of aggregate is just below the surface.

    f. As soon as the concrete has achieved a firm set, begin simultaneously brushing and hosting the surface with water so as to achieve a clean, uniform surface with no aggregate exposed more than 1/8-inch.

    g. Do not dislodge or unevenly expose the surface so as to take on a “bald” spot appearance. Doing so may lead to paving rejection.

3.3 REPAIRS AND PROTECTION

A. Remove and replace decorative cement concrete pavement that is broken, damaged, or does not comply with requirements in this Section in complete sections from joint to joint, unless otherwise approved by College’s Representative.

B. Detailing: Grind concrete "squeeze" left from tool placement. Remove excess release agent with high-velocity blower.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain decorative cement concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep decorative cement concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

Section 328400
IRRIGATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping, valves, sprinklers, specialties, controls, and wiring for automatic control irrigation system.

B. It is the intent of the specifications and drawings that the finished system is complete in every respect and to be ready for operation satisfactory to the College.

C. The work to include all materials, labor, services, transportation, and equipment necessary to perform the work as indicated on the drawings, in these specifications, and as necessary to complete the Contract.

D. Related Sections

1. 01 56 39 Tree and Plant Protection
2. 03 30 00 Cast-in-place Concrete
3. 5. 31 10 00 Site Clearing
4. 6. 31 22 00 Grading
5. 7. 31 23 16 Excavation
6. 8. 31 23 23 Fill: Compacted Subbase for Paving
7. 11. 32 13 13 Concrete Paving
8. 12. 32 13 16 Decorative Concrete Paving
9. 14. 32 93 13 Lawns and Grasses
10. 15. 32 93 16 Exterior Plants
11. 16. 33 41 11 Storm Utility Drainage Piping

1.2 DEFINITIONS

A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

C. Irrigation Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

D. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.

2. FRP: Fiberglass-reinforced plastic.

3. PA: Polyamide (nylon) plastic.

4. PE: Polyethylene plastic.

5. PP: Polypropylene plastic.

6. PTFE: Polytetrafluoroethylene plastic.

7. PVC: Polyvinyl chloride plastic.

8. TFE: Tetrafluoroethylene plastic.

E. Notice of Completion: The date at the close of the Maintenance Period when the work has been completed, checked, accepted, and written approval of the work has been given by the College's Representative.

F. Date of Acceptance: The date at the end of the warranty periods as specified herein, and written acceptance has been given by the College's Representative.

G. Finish Grade: Elevation of finished surface of planting soil within 1/10th of an inch.

1.3 CONSTRUCTION DRAWINGS

A. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor to carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work to be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.

B. All work called for on the drawings by notes or details to be furnished and installed whether specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it to be deemed to be as shown on both.

C. The Contractor to not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been. Such obstructions or differences should be brought to the attention of the College's Representative as soon as detected. In the event this notification is not performed, the Contractor to assume full responsibility for any revision necessary.

1.4 PERFORMANCE REQUIREMENTS

A. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent water coverage of turf and planting areas indicated.

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.

1.5 SUBMITTALS

A. Product Data:

1. Include pressure ratings, rated capacities, and settings of selected models for the following:

    a. Irrigation controllers: Must be compatible with existing Centralized Irrigation System of the College

    b. Master Valves

    c. Flow Sensors

    d. General-duty valves, Remote Control Valves Isolation Valves, Quick Couplers

    e. Control-valve boxes.

    f. Sprinklers, Bubblers, Check Valves

    g. Irrigation specialties.

    h. Control cables. Include splice kits

2. After award of contract and before any irrigation system materials are delivered to the job site, submit to the College's Representative a complete list of all irrigation systems, materials, or processes proposed to be furnished and installed as part of this contract.

3. The submittals to include the following information:

    a. A title sheet with the job name, the Contractor's name, Contractor's address and telephone number, submittal date and submittal number.

    b. An index sheet showing the item number (i.e. 1,2,3, etc.); an item description (i.e. sprinkler head); the manufacturer's name (i.e. Hunter Industries); the item model number (i.e. I-40-ADV/36V); and the page(s) in the submittal set that contain the catalog cuts.

    c. The catalog cuts to be one or two pages from the most recent manufacturer's catalog that indicate the product submitted. Do not submit parts lists, exploded diagrams, price lists or other extra information.

    d. The catalog cuts to clearly indicate the manufacturer's name and the item model number. The item model number, all specified options and specified sizes to be circled or highlighted on the catalog cuts.

    e. Submittals for equipment indicated on the legend without manufacturer names, or "as approved", to contain the manufacturer, Class or Schedule, ASTM numbers and/or other certifications as indicated in these specifications.

    f. Submittal format requirements:

        i. Submittals to be provided as one complete package for the project. Multiple partial submittals will not be reviewed.

ii. Submittal package to be stapled or bound in such a way as to allow for disassembly for review processing.

iii. Submittal package to have all pages numbered in the lower right hand corner. Page numbers to correspond with submittal index.

4. Manufacturer's warranties to not relieve the Contractor of his liability under the guarantee. Such warranties to only supplement the guarantee.

B. Shop Drawings: Show irrigation system piping, including plan layout, and locations, types, sizes, capacities, and flow characteristics of irrigation system piping components. Include water meters, backflow preventers, valves, piping, sprinklers and devices, accessories, controls, and wiring. Show areas of sprinkler spray and overspray. Show wire size and number of conductors for each control cable.

C. Coordination Drawings: Show piping and major system components. Indicate interface and spatial relationship between piping, system components, adjacent utilities, and proximate structures.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For irrigation systems, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include data for the following:

1. Automatic-control valves.

2. Sprinklers.

3. Controllers.

F. Reduced plan for automatic controller.

G. Controller watering schedule log.

H. As-built Drawings:

1. As-built accurately on one set of Contract Drawings all changes in the work constituting departures from the original Contract Drawings.

2. As-built drawing information and dimensions to be collected on a day-to-day basis during the installation of the pressure mainline to fully indicate all routing locations and pipe depths. Locations for all other irrigation equipment to be collected prior to the final inspection of the work.

3. The changes and dimensions to be recorded in a legible and workmanlike manner to the satisfaction of the College. Prior to final observation of work, submit As-built Drawings to the College’s Representative.

4. Dimensions from two permanent points of reference such as buildings, sidewalks, curbs, etc. to be shown. Data on As-built drawings to be recorded on a day-to-day basis as the project is being installed. All lettering on drawings to be minimum 1/8 inch in size.

5. Show locations and depths of the following items:

a. Point of connection (including water POC, master control valves, flow sensors, etc.)

b. Routing of sprinkler pressure lines (dimensions shown at a maximum of 100 feet along routing)

c. Isolation valves

d. Automatic remote control valves

e. Quick coupling valves

f. Routing of control wires

g. Related equipment (as may be directed)

h. Drip system air relief valves

i. Drip system flush QC valves

j. Sleeves

6. Maintain As-built drawings on site at all times. Upon completion of work, transfer all as-built information and dimensions to reproducible prints.

I. Controller Charts:

1. College's Representative must approve As-built drawings before charts are prepared.

2. Provide one controller chart for each automatic controller. Chart to be color-coded to clearly show valve location and area covered by the particular controller.

3. Controller charts to include all drip system air relief and flush QCV's.

4. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible when the drawing is reduced, it to be enlarged to a readable size.

5. When completed and approved by College's Representative, the chart to be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness.

6. Submittal of controller charts to be required before final observation and start of maintenance period walk-through.

J. Operation and Maintenance Manuals:

1. Six individually bound copies of operation and maintenance manuals to be delivered to the College's Representative at least 10 calendar days prior to final observations. The manuals to describe the material installed and the proper operation of the system. Refer to Division 1 of specifications.

2. Each complete, bound manual to include the following information:

a. Index sheet stating Contractor's address and telephone number, duration of warranty period, list of equipment including names and addresses of local manufacturer representatives.

b. Operating and maintenance instructions for all equipment.

c. Spare parts list and related manufacturer information for all equipment.

K. Irrigation Schedule:

1. Supply as a part of this contract the following items:

a. One shop drawing of a bi-weekly irrigation-watering schedule for a 12-month period for approval by the College's Representative.

1.6 QUALITY ASSURANCE

A. Provide at least one person who holds a current Certified Landscape Technician (CLT) certificate with the California Landscape Contractors Association (CLCA) as foreman to be present at all times during execution of this portion of the work and who is thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who to direct all work performed under this section.

B. Provide photocopies of the current CLT registration for all foreman performing work on this project.

C. Manufacturer's directions and detailed drawings to be followed in all cases where the manufacturer of articles used in this contract furnish directions covering points not shown in the drawings and specifications.

D. All materials supplied for this project to be new or the manufacturer's current product at bid time or at least no more than 12 months old at the time of installation) and free from any defects. All defective materials to be replaced immediately at no additional cost to College.

E. The Contractor to secure the required licenses and permits including payments of charges and fees, give required notices to public authorities, verify permits secured or arrangements made by others affecting the work of this section.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Use all means necessary to protect irrigation system materials from damage and theft before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage or theft, immediately make all repairs and replacements necessary to the acceptance of the College's Representative and at no additional cost to the College.

B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

C. Deliver piping 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.

D. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by College or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify College's Representative no fewer than two days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without College's Representative's written permission.

B. The Contractor to verify and be familiar with the locations, size and detail of points of connection provided as the source of water, and electrical supply.

C. Irrigation design is based on the available static water pressure shown on the drawings. Contractor to verify static water on the project prior to the start of construction. Should a discrepancy exist, notify the College's Representative prior to beginning construction.

D. Prior to cutting into the soil, the Contractor to locate all cables, conduits, sewer septic tanks, and other utilities as are commonly encountered underground and he to take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the Contractor to promptly notify the College's Representative. The Contractor to proceed in the same manner if a solid rock obstruction or any other such conditions are encountered.

E. The Contractor to protect all existing utilities and features to remain on and adjacent to the project site during construction. Contractor to repair, at his own cost; all damage resulting from his operations or negligence.

F. The Contractor to coordinate installation of required sleeves as shown on the plans.

1.9 EXISTING IRRIGATION SYSTEM

A. The Contractor to verify and be familiar with the existing irrigation systems in areas adjacent to and within the Project area of work.

B. The Contractor to protect all existing irrigation systems, in areas adjacent to and within the project area of work, from damage due to his operations.

C. Contractor to notify College's Representative if any existing system is temporarily shut off, capped or modified. Provide 48-hour notice, prior to turning off of modifying any existing irrigation system.

D. The Contractor to repair or replace all existing irrigation systems, in areas adjacent to and within the project area of work, damaged by the construction of this project. As shown on the Drawings, adjacent irrigation systems to be made completely operational and provide complete coverage of the existing landscaped areas. All repairs to be completed to the satisfaction of the College's Representative.

1.10 CONSTRUCTION OBSERVATIONS

A. Where the specifications require work to be tested by the Contractor, it shall not be covered over until accepted by the College's Representative. The Contractor to be solely responsible for notifying the College's Representative, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing. Should any work be covered without testing or acceptance, it to be, if so ordered, uncovered at the Contractor's expense.

B. Reviews will be required for the following at a minimum:

1. Pressure test of irrigation mainline (four hours at 150 PSI or 120% of static water pressure, whichever is greater.) Mainline pressure loss during test to not exceed 2 PSI.

2. System layout.

3. Flushing of system and verification of proper operating pressure at last head in specified zones.

4. Coverage test of irrigation system.

5. Final observations prior to start of maintenance period.

6. Final acceptance.

C. Site observations and testing will not commence without current as-built drawings prepared by the Contractor. As-built mark-ups/drawings must be up to date at each site visit.

D. Work that fails testing and is not accepted will be re-tested. The Contractor will re-test at no additional expense to the College.

1.11 CLEANUP RECYCLING AND DISPOSAL

A. Dispose of waste, trash, and debris in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no such waste material and debris on the site. Burning of trash and debris will not be permitted. The Contractor to remove and dispose of rubbish and debris generated by his work and workmen at frequent intervals or when ordered to do so by the College's Representative.

B. At the time of completion, the entire site will be cleared of tools, equipment, rubbish and debris which to be disposed of off-site in a legal disposal area.

C. All recyclable materials are to be properly removed from site and weight tickets of the recycled materials is to be turned over to the college's Representative.

1.12 EXTRA MATERIALS

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. Two (2) wrenches for disassembly and adjustment of each type of sprinkler head used in the irrigation system.

2. One quick coupler key with a 1" bronze hose bib, bent nose type with hand wheel and two coupler lid keys.

3. One valve box cover key or wrench.

4. Three extra sprinkler heads of each size and type.

B. The above equipment to be turned over to College's Representative at the final observation walk through.

1.13 COMPLETION

A. A 48-hour notice to be given before any site requested observations. At the time of the pre-maintenance period observation, the College's Representative, and if not accepted, will prepare a list of items (punch list) to be completed by the Contractor. Punch list to be checked off by Contractor and submitted to College's Representative prior to any follow-up meeting. This checked off list to indicate that all punch list items have been completed. At the time of the post-maintenance period or final observation the work will be re-observed/reviewed and final acceptance will be in writing by the College's Representative.

B. All final turnover items to be submitted prior to, or no later than final acceptance.

C. The College's Representative to have final authority on all portions of the work.

D. After the system has been completed, the Contractor to instruct College's Representative in the operation and maintenance of the irrigation system and to furnish a complete set of operating and maintenance instructions.

1.14 WARRANTY

A. The entire sprinkler system, including all work done under this contract, to be unconditionally guaranteed against all defects and fault of material and workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the filing of the Notice of Completion.

B. Should any problem with the irrigation system be discovered within the warranty period, the Contractor at no additional expense to College should correct it within ten (10) calendar days of receipt of written notice from the College. When the nature of the repairs as determined by the College constitute an emergency (i.e. broken pressure line) the College may proceed to make repairs at the Contractor expense. The Contractor, all at no additional cost to the College, to repair any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, to the satisfaction of the College.

C. Any settling of trenches from Finish Grade which may occur during the one-year period following acceptance to be repaired to the College's satisfaction by the Contractor without any additional expense to the College. Repairs to include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

1.15 MAINTENANCE

A. Maintenance period to be for 90 days. During the maintenance period the Contractor to adjust and maintain the irrigation system in a fully operational condition providing complete irrigation coverage at all times to all intended plantings.

PART 2 - PRODUCTS

2.1 EXISTING IRRIGATION SYSTEM

A. The Contractor to repair or replace any existing irrigation systems damaged by this construction with products of the same manufacturer, model and size as originally used in existing irrigation system.

B. Should any of the existing irrigation equipment no longer be available, new equipment consistent with the equipment indicated on the drawings and described in these specifications to be used to replace the unavailable equipment.

C. Existing equipment that will be expected to be repaired or replaced if damaged will include, but is not limited to; irrigation controllers, remote control valves, remote control valve conductors, isolation valves, quick coupler valves, valve boxes, sprinkler heads, drip equipment, mainlines and lateral lines.

D. The Contractor to be required to flush any system that demands repair or replacement. All requirements under Part 1: CONSTRUCTION OBSERVATIONS to apply to the repair and/or replacement of existing systems.

2.2 PLASTIC PIPE AND FITTINGS

A. All pipe and fittings shall be reclaimed water PVC pipe to be color-coded purple in color marked on two sides with reclaimed water warning statements “Caution-Reclaimed Water”. Reclaimed water piping must be accepted by the local reclaimed water governing agencies.

B. Pressure supply line larger than 3 inches in diameter to be Class 315 PVC bell and gasket with iron fittings/restraints. This section needs MCC’s review.

C. Pressure supply lines 2 ½ inches in diameter and up to 3 inches in diameter downstream of the backflow prevention unit to be Class 315 solvent weld PVC conforming to ASTM D1785.

D. Pressure supply lines 2 inches in diameter and smaller downstream of the backflow prevention unit to be Schedule 40 solvent weld PVC conforming to ASTM D1785.

E. Non-pressure lines 3/4 inch in diameter and larger downstream of the remote control valve to be SCH 40 solvent weld PVC conforming to ASTM D1785.

F. Threaded PVC pipe and nipples to be PVC sch. 80. All threaded fittings and nipples to be wrapped with teflon tape prior to assembly. No liquid tape.

G. 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.

H. All plastic pipes to be extruded of an improved PVC virgin pipe compound in accordance with ASTM D2241 or ASTM D1784.

I. All solvent weld PVC fittings to be standard weight Schedule 40 and (Schedule 80 where specified on the irrigation drawings) and to be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings to be the "deep socket" bracketed type. Threaded plastic fittings to be injection molded. All tees and ells to be side gated. All fittings to conform to ASTM D2466.

J. All threaded nipples to be standard weight Schedule 80 with molded threads and to conform to ASTM D1785.

K. All plastic pipe pressure lines to be solvent welded with a two-step process, using primer and solvent cement. All non-pressure laterals to be solvent welded with a one-step integral primer/solvent. Cement to be of a fluid consistency, not gel-like or ropy. Solvent cementing to be in conformance with ASTM D2564 and ASTM D2855.

L. 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.

2.3 VALVES

A. Ball Valves

1. Ball valves to be constructed of a full port bronze body, stainless steel ball, stem and stainless steel handle and is to be installed with the handle in an upward position when turned off.

2. All ball valves to have a minimum working pressure of not less than 150 PSI and to conform to AWWA standards.

3. Use ball valves at point of connection, mainline change of direction and at points of isolation for manifolds and quick couplers.

4. Bronze ball valves to have a recycled water warning ID tag (for recycled systems) attached to the valve stem.

B. Quick Coupler Valves:

1. Quick coupler valve shall be Rain Bird 44LRC (Locking Rubber Cover), with Snap-Lokpre-assembled PVC swing joint with male brass stabilizer elbow and purple Snap-Lok collar manufactured by LASCO. Assembly to be housed in a CARSON 910 circular valve box supported by three (3) bricks with gravel beneath and up to base of coupler.

C. Master Valves

1. Remote control valves to be as manufactured by Weathermatic, model number 8200CR Bronze valve. Size per drawings. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

2. Remote control valves to be electrically operated.

3. Remote control valves to have a recycled water warning ID tag (for recycled systems) attached to the valve stem.

D. Remote Control Valves:

1. Remote control valves to be as manufactured by Weathermatic, model number 8200CR Bronze valve. Size per drawings. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

2. Remote control valves to be electrically operated.

3. Remote control valves to have a recycled water warning ID tag (for recycled systems) attached to the valve stem.

2.4 VALVE BOXES

A. Valve boxes to be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils as manufactured by CARSON, to match existing. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

B. The valve box cover to be of the overlapping type and secured with a hidden latching mechanism or bolts.

C. The cover and box to be capable of sustaining a load of 1,500 pounds.

D. Cover and box to be purple (reclaimed water).

E. Valve box extensions to be by the same manufacturer as the valve box.

F. Automatic control valve boxes to be CARSON 1419 12” depth rectangular model for typical remote control valves. No heat-branded identification lettering on RCV valve boxes (college standard).

G. Ball valve and quick coupler valve boxes to be CARSON 910 10” round model. Valve box covers to be marked with either "BV" or "QCV" "heat branded" onto the cover in 2-inch high letters.

2.5 TAGS FOR VALVES AND IRRIGATION COMPONENTS

A. Provide 2-sided tags for all valves and irrigation component identification as manufactured by Christy, to match existing. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

2.6 IRRIGATION CONTROL SYSTEM COMPONENTS

A. Irrigation Controller Unit: Irrigation controller shall be Weathermatic SL4800 w/SLM12 – 12 Zone Module. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

B. Weather Sensor: Weather sensor shall be Weathermatic model # SLW5. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

C. Flow Sensor: Flow sensor shall be Weathermatic model # SLFSI-T20, SLFSI-S30 or SLFSI-S40.This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

D. Flow Communication: Flow communication module shall be Weathermatic SL-AIRCARDFLOW. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

2.7 ELECTRICAL

A. All electrical equipment to be NEMA Type 3, waterproofed for exterior installations.

B. All electrical work to conform to local codes and ordinances.

2.8 LOW VOLTAGE CONTROL WIRING

A. Remote control wire to be direct-burial AWG-UF type. Wires to be AWG 14 (black or red only) for control, and AWG 14 (white only) for common.

1. Wire Splice Connectors to be SPEARS, model DS-400. This is a necessary item, that is only available from the listed source, or it is required to match existing Campus standards, and no other product to be furnished.

2.9 IRRIGATION HEADS

A. Description: Brass or plastic housing and corrosion-resistant interior parts designed for uniform coverage over entire spray area indicated, at available water pressure.

B. Irrigation heads to be of the manufacturer, size, type, with radius of throw, operating pressure, and discharge rate indicated on the drawings unless otherwise specified below.

1. Bubbler Nozzles – Hunter MSBN-50H or as noted on drawings.

2. Spray head Bodies with factory installed pressure regulator and check valve, 4-inch (for tree bubbler) 6- inch (at turf), and 12-inch (at shrub/bioswale) pop up with non-potable water use indicating cover as manufactured by Rain Bird. Install triple swing joint assembled together with marlex street ells, PVC SCH 80 threaded nipples and PVC SCH 40 threaded ells.

3. Rotary Nozzles as manufactured by Hunter Industries, model MP Rotator Series.

C. Irrigation heads to be used as indicated on the drawings.

2.10 MISCELLANEOUS EQUIPMENT

A. Equipment such as rain sensors (SLW5), flush valves, flow sensors, basket strainers, and master valves to be of the manufacturer, size and type indicated on the drawings. District specified choice: Weathermatic

PART 3 - EXECUTION

3.1 PREPARATION

A. Observations:

1. Prior to all work of this section, carefully observe/review the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the College’s Representative.

2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.

C. Grades:

1. Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.

2. Final grades to be accepted by the College's Representative before work on this section will be allowed to begin.

D. Field Measurements:

1. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor to coordinate the installation of all irrigation materials with all other work.

2. All scaled dimensions are approximate. The Contractor to check and verify all size dimensions prior to proceeding with work under this section.

3. Exercise extreme care in excavating and working near existing utilities. Contractor to be responsible for damages to utilities that are caused by his operations or neglect.

E. Diagrammatic Intent:

1. The drawings are essentially diagrammatic for the purpose of drawing clarity. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform to structures and to avoid obstructions or conflicts with other work at no additional expense to College.

F. Layout:

1. Prior to installation, the Contractor to stake out all pressure supply lines, routing and location of sprinkler heads, valves, and backflow device, and automatic controller. Obtain College's Representative's approval before excavation.

2. Layout irrigation systems and make minor adjustments required due to differences between site and drawings. Where piping is shown on the drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.

G. Water Supply:

1. Connections to, or the installation of, the water supply area to be at the locations shown on the drawings. Changes caused by actual site conditions to be made at no additional expense to College.

3.2 EARTHWORK

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

B. Install Christy's detectable warning tape as described in the irrigation legend directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

C. Excavations to be straight with vertical sides, even grade, and support pipe continuously on bottom of trench. Trenching excavation to follow layout indicated on drawings to the depths below

finished grade and as noted. Where lines occur under paved area, these dimensions to be considered below sub grade.

D. Install piping and wiring in sleeves under sidewalks, roadways, parking lots, and railroads.

1. Install piping sleeves by boring or jacking under existing paving if possible.

E. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Provide minimum cover of 18 inches on pressure supply lines 2 ½ inches and smaller in landscaped areas.

a. Mainlines over 2 ¼’ inches provide minimum cover of 18 inches minimum on pressure supply lines.

2. Circuit Piping: Provide minimum cover of 12 inches for non-pressure lines in landscaped areas.

3. Drain Piping: 12 inches.

4. Sleeves under Sidewalks and pathways: Provide 18” below sidewalks and pathways for both pressure supply lines and non-pressure lateral lines. Sleeves need to extend a minimum of 6” beyond the edges of the sidewalks and pathways.

5. Sleeves under Roadway: Provide 36” below paving for pressure supply line. Provide 24” cover for non-pressure lines and wire sleeves.

6. Provide minimum cover of 18 inches for control wires in landscaped areas. Control wires should, where possible, share the same trench as the pressurized mainlines and be separated by 6 inches and not allowed to cross wrap or snake around the mainline.

7. Pipes installed in a common trench to have a 4-inch minimum space between pipes.

3.3 BACKFILLING

A. Backfill material on all lines to be the same as adjacent soil free of debris, litter, and rocks over 1/2 inch in diameter.

B. Backfill to be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Backfill materials to be sufficiently damp to permit thorough compaction, free of voids. Backfill to be compacted to 85% relative dry density in planting areas, dry density equal to adjacent undisturbed soil and to conform to adjacent grades.

C. Flooding in lieu of tamping is not allowed.

D. Under no circumstances to truck wheels be used to compact backfill.

E. Provide sand backfill a minimum of 6 inches over and under all piping under paved areas.

F. Backfilling of mainlines prior to pressure testing is not allowed. Only center loading of mainlines prior to testing is acceptable to allow all mainline joints and fittings to be visible during testing.

3.4 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.

C. Install piping free of sags and bends.

D. Install groups of pipes parallel to each other, spaced to permit valve servicing.

E. Install fittings for changes in direction and branch connections.

F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.

G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.

H. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphalt pavement.

I. Piping in control-valve boxes and above ground may be joined with flanges instead of joints indicated.

J. Carefully inspect all pipe and fittings before installation, removing dirt, scale, burrs, and reaming. Install pipe with all markings up for visual inspection and verification.

K. Remove all dented and damaged pipe sections.

L. All lines to have a minimum clearance of 4 inches from each other and 12 inches from lines of other trades.

M. Parallel lines to not be installed directly over each other.

N. In solvent welding, use only the specified primer and solvent cement and make all joints in strict accordance with the manufacturer's recommended methods including wiping all excess solvent from each weld. Allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.

O. PVC pipe to be installed in a manner, which will provide for expansion and contraction as recommended by the pipe manufacturer.

P. Center load all plastic pipe prior to pressure testing.

Q. All threaded plastic-to-plastic connections to be assembled using Teflon tape or Teflon paste.

R. For plastic-to-metal connections, work the metal connections first. Use a non-hardening pipe dope an all threaded plastic-to-metal connections, except where noted otherwise. All plastic-to-metal connections to be made with plastic male adapters.

S. Install dielectric fittings to connect piping of dissimilar metals.

T. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.

U. Lay piping on solid subbase, uniformly sloped without humps or depressions.

V. Install Thrust Blocks or Kick Blocks at locations where mainlines turn at 45's or 90's or where tees are installed.

W. Install ductile iron-piping according to AWWA C600.

X. Install PVC piping in dry weather when temperature is above 40 deg F 5 deg C. Allow joints to cure at least 24 hours at temperatures above 40 deg F 5 deg C before testing unless otherwise recommended by manufacturer.

Y. Pressure Test: All pressure lines to be tested under hydrostatic pressure.

Z. Coverage Test: When the sprinkler system is completed a coverage test to determine if coverage is complete and adequate to be performed.

3.5 CONTROL WIRING

A. Low voltage control wiring to occupy the same trench and to be installed along the same route as the pressure supply lines whenever possible.

B. Where more than one wire is placed in a trench, the wiring to be taped together in a bundle at intervals of 10 feet. Bundle to be placed alongside the mainline and separated by 6 inches and not allowed to cross wrap or snake around mainline. Metallic defector tape should be place above the wire bundle at the depth of 12 inches below finish grade. All connections to be of an approved type and to occur in a valve box. Provide an 18-inch service loop at each connection.

C. An expansion loop of 12 inches to be provided at each wire connection and/or directional change, and one of 24 inches to be provided at each remote control valve.

D. A continuous run of wire to be used between a controller and each remote control valve. Under no circumstances to splices be used.

3.6 VALVE INSTALLATION

A. Automatic control valves, quick coupler, and isolation valves are to be installed in the approximate locations indicated on the drawings.

B. Valves to be installed in shrub areas whenever possible.

C. Install all valves as indicated in the detail drawings.

D. Valves to be installed in valve boxes to be installed one valve per box.

3.7 VALVE BOX INSTALLATION

A. Valve boxes to be installed in shrub areas whenever possible.

B. Each valve box to be installed on a foundation of 3/4 inch gravel backfill, 6" deep extending 6" beyond the perimeter of the box, minimum. Valve boxes to be installed with their tops 1/2 inch above the surface of surrounding finish grade in lawn areas and 3 inches above finish grade in ground cover areas.

C. Valve boxes are to be supported by bricks set into gravel foundation.

D. Seal all below-grade opening in valve boxes and around piping to prevent soil from entering the valve box through the use of geotextile fabric. Do not use cardboard duct tape or other materials that will deteriorate in wet conditions.

3.8 IRRIGATION HEADS AND DRIP TUBING INSTALLATION

A. Irrigation heads to be installed as indicated on the drawings.

B. Spacing of heads to not exceed maximum indicated on the drawings.

C. Riser nipples to be of the same size as the riser opening in the sprinkler body.

D. Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.

E. Locate part-circle sprinklers to maintain a minimum distance of 12 inches from walls and other boundaries in shrub areas and 3 inches from boundaries in turf areas, unless otherwise indicated.

F. Install drip irrigation per manufacturer’s recommendations and details.

3.9 MISCELLANEOUS EQUIPMENT

A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.

B. Quick coupler valves to be set approximately within 18 inches from walks, curbs, header boards, or paved areas where applicable.

C. Install devices such as flow sensors as indicated on the drawings and as recommended by the manufacturer.

3.10 FIELD QUALITY CONTROL

A. Refer to Part 1 “Construction Observations’ Article for all field quality control requirements.

3.11 STARTUP SERVICE

A. Verify that controllers are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

C. Complete startup checks according to manufacturer's written instructions.

D. Prior to installation of irrigation heads, the valves to be opened and a full head of water used to flush out the lines and risers.

E. Irrigation heads to be installed after flushing the system has been completed.

F. All drip-tubing lines to be open prior to flushing. As lines are flushed the tubing ends may be connected together per plan.

3.12 ADJUSTING

A. Contractor to adjust valves, align heads, and check the coverage of each system prior to coverage test.

B. If it is determined by the College's Representative that additional adjustments or nozzle changes will be required to provide proper coverage, all necessary changes or adjustments to be made prior to any planting.

C. The entire system to be operating properly before any planting operations commence.

D. Automatic control valve pressure regulators are to be adjusted so that the irrigation heads and drip tubing operate at the pressure recommended by the manufacturer.

E. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

F. Adjust sprinklers so they will be flush with, or not more than 1/2 inch above, finish grade.

3.13 EXISTING IRRIGATION SYSTEM

A. All repair or replacement of the existing irrigation systems to be consistent with the methods indicated on the drawings and as described in these specifications.

B. If existing equipment is significantly different from the equipment indicated on the drawings and described in these specifications, the Contractor to install the equipment in a manner consistent with the manufacturer's recommendations.

C. Sprinkler system lines and wires that cross into the area of new construction to be identified as to which systems they serve outside the limit of work area. Any existing wires to existing valves to be demolished within limit of work area are to be abandoned in place or cut and capped at the locations where splicing would occur where wires are to be extended to new systems. If the remote control valves that control an area are located outside the limit of work, and were connected to the existing controller within the limit of work, they are to be protected in place to the greatest degree possible. If damaged, the wires shall be replaced in kind, using approved, waterproof wire splice connectors and splices placed in splice boxes. All wires, new or existing-to-remain, and valves that exist or are new shall be completely operational by the end of project construction.

D. Major equipment such as controllers, isolation valves and mainline to be relocated as required to continue service to existing irrigation systems outside of the area of new work, shall be relocated as required to provide uninterrupted water service to all areas under service.

3.14 TESTING AND OBSERVATION

A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been observed, tested and accepted by the College's Representative.

B. The Contractor to be solely responsible for notifying the College's Representative a minimum of 48 hours in advance, where and when the work is ready for testing.

C. When the sprinkler system is completed, the Contractor to perform a coverage test of each system in its entirety to determine if the water coverage for the planted areas is complete and adequate in the presence of the College's Representative.

D. The Contractor to furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from the plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate, without bringing this to the attention of the College's Representative. This test to be accepted by the College's Representative and accomplished before starting any planting.

E. Final observations will not commence without As-built drawings as prepared by the Design-Builder.

3.15 CLEAN UP

A. As the work progresses, maintain areas in a neat, clean orderly manner, and remove unsightly debris as necessary. At the completion of the work, sweep and clean all walks, parking and other paved areas adjacent to plantings.

B. During irrigation installation, keep adjacent paving and construction clean and work area in an orderly condition.

C. Protect exterior plants, lawns and hydroseeding from damage due to landscape operations, operations by other Contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

D. Any damage sustained on the work of others to be repaired to original conditions.

E. Flush dirt and debris from piping before installing sprinklers and other devices.

3.16 DISPOSAL

A. Disposal: All grubbed material, rock, surplus soil and waste material, including excess subsoil, unsuitable soil, trash and other debris to be removed from the College's property and disposed of in a legal disposal site.

B. Recycling: All recyclable materials are to be properly removed from site and weight tickets of the recycled materials to be turned over to the College's Representative.

3.17 DEMONSTRATION

A. Engage a factory-authorized service representative to train College's maintenance personnel to adjust, operate, and maintain controller and automatic control valves. Refer to Division 1 Section "Closeout Procedures."

3.18 MAINTENANCE

A. General Irrigation: Continually maintain irrigation system in working order, adjusting system for proper soil moisture content, proper operating pressure, proper coverage including elimination of overspray or run off.

B. Watering Schedule Log: Maintain an irrigation controller water schedule log during construction and maintenance indicating water schedules and changes.

C. Maintenance Specifications: Provide complete annual maintenance specifications including general irrigation system design intent and estimated watering schedule based on planting and irrigation system design.

END OF SECTION

Section 329313

LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section Includes: Seeding, Hydroseeding, Plugging, Meadowgrass and wildflower, Turf installation, turf establishment and minimum 90 days maintenance.

B. Related Sections

1. 01 56 39 Tree and Plant Protection
2. 03 30 00 Cast-in-place concrete
3. 5. 31 10 00 Site Clearing
4. 6. 31 22 00 Grading
5. 7. 31 23 16 Excavation
6. 8. 31 23 23 Fill: Compacted Subbase for Paving
7. 11. 32 13 13 Concrete Paving
8. 12. 32 13 16 Decorative Concrete Paving
9. 14. 32 84 00 Landscape Irrigation
10. 15. 32 93 16 Exterior Plants
11. 16. 33 41 11 Storm Utility Drainage Piping

1.2 GENERAL REQUIREMENTS/DEFINITIONS

A. Notice of Completion: The date at the close of the Maintenance Period when the work has been completed, checked, accepted, and written approval of the work has been given by the College's Representative.

B. Date of Acceptance: The date at the end of the warranty periods as specified herein, and written acceptance has been given by the College's Representative.

C. Finish Grade: Elevation of finished surface of planting soil within 1/10th of an inch.

D. Import soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

E. Native Soil: Soil found in place in the designated landscape area, including soil compacted in place as part of the earthwork specified for the project.

F. Planting Area: Areas to be planted with trees, shrubs, groundcovers, lawn, or seed, or areas to be covered with various gravel or stone mulches not intended for pedestrian or vehicular circulation.

G. Planting Soil: Native or imported soil modified to become planting soil; mixed with soil amendments.

H. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

I. To Remain: Protect and maintain at all times the existing plant material as identified on the Drawings.

J. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

K. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, ground squirrels, voles and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

1.3 SUBMITTALS

A. Soil Analysis:

1. Soil Analysis: Soil analysis test reports shall be completed after rough grading to determine actual recommended soil amendments. Refer to Part 1.05 Soil Testing.

B. Product Data and Samples:

1. Product Data: For each type of product specified.

2. Soil amendments and fertilizers: Submit supplier/manufacturer’s product data on amendments and fertilizers as noted. Include brand names, estimated quantities, and supplier.

C. Certification of Grass Sod: From sod vendor for each sod type. Refer to drawings for sod species and vendor.

D. Qualification Data: For landscape Installer. Refer to Part 1, Section “Quality Assurance”.

E. Material Test Reports: For existing surface soil and imported topsoil.

F. Planting Schedule: Indicating anticipated planting dates for each type of planting.

G. Maintenance Instructions: Prepare instructions for maintenance in cooperation with the Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods. Instructions shall include but not be limited to the following tasks:

1. Fertilizing

2. Irrigation schedule

1.4 QUALITY ASSURANCE

A. Installer Qualifications: All of the work required to be provided as described in this Section of the Specifications shall be provided by a single entity sub-contractor skilled in this specialty, holding a valid C-27 California contractor's license.

B. The qualified landscape installer shall exhibit work that has resulted in successful lawn and seed establishment. Submitted qualifications shall include a client list with contact names, phone numbers and date lawn was installed.

C. All work shall be performed by a trained crew company in accordance with the standards and practices related to the trade.

D. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

E. Full-time Supervisor: Require full-time Supervisor to hold a current Certified Landscape Technician (CLT) certificate with the California Landscape Contracts Association (CLCA) to be present at all times during execution of this portion of the work wo is thoroughly familiar with the type of installation and who is to direct all work performed under this section.

F. Provide photocopies of the current CLT registration for all foreman performing work on this project.

G. Reference Standards: Reference Standards apply to this Sections and shall be the latest edition of the following:

1. “Seed Laws” State of California Department of Food and Agriculture

2. “Seed Laws” U.S. Department of Agriculture

3. Hortus Third

4. Sunset Western Garden Book, Sunset Publishing Corporation

5. The Jepson Manual, Owner of California Press, Berkeley

1.5 SUBMITTALS

A. SOIL TESTING

1. Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

a. Supply Soil Testing Laboratory with complete copy of 32 93 13 specification sections at time of soil tests.

2. Soil Testing After Rough Grading

a. At the conclusion of rough grading, collect soil samples per plan (minimum 5), and submit the samples to an agricultural soils laboratory for testing. Submit the test results to the College’s Representative for review. No amendments shall be applied prior to receipt of test results. The College’s Representative shall recommend changes to the amendments and/or procedure listed herein, after

review of the test results. Costs for testing shall be included in the contract. Changes in amendments and/or procedures shall be authorized by the Owner in accordance with the provisions of the General Conditions Article “Changes in the Work”.

b. A soil analysis shall be made after rough grading operations are complete to determine actual recommended soil amendments.

c. Soil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter, textural classification, textural tests, silt sand clay content, sodium absorption rate (SAR), electrical conductivity (ECe), cation exchange capacity, boron content, deleterious material, pH, mineral and plant-nutrient content of topsoil and elemental data, corrective recommendations and soil amendment recommendations.

d. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil.

B. Qualification Data: For landscape Installer.

C. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

D. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

1.6 OBSERVATION

A. College’s Representative may observe lawn and seed mixes on site before planting for compliance with requirements for genus, species, variety, size, and quality. College’s Representative retains right to observe lawn further for size and condition of root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove lawn immediately from Project site.

1. Notify College’s Representative of sources of sod fourteen days in advance of delivery to site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Sod: Deliver sod to be planted at time of delivery.

1.8 COORDINATION

A. Planting Restrictions: Plant during one spring or fall. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

B. Weather Limitations: Proceed with planting and seeding only when existing and forecasted weather conditions permit.

C. Coordination with Exterior Plants: Plant trees and shrubs after finish grades are established and before planting lawns, from sod or seed, unless otherwise acceptable to College's Representative.

1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.9 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Sodded Lawns: 90 days minimum from date of Final Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

2. Seeded areas: 90 days minimum from date of Final Completion.

a. Begin maintenance immediately after each area has established enough root growth to withstand any damage from maintenance foot traffic, equipment, and other exposures typical of turf maintenance and continue until acceptable seeding is established (100% coverage with no weeds), but not less than 90 days from date of substantial completion.

B. Maintain seeding by watering, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and re-mulch as needed to provide 100% coverage.

C. Within one week following authorization to start maintenance period, submit a Maintenance Schedule to the College's Representative listing the days when maintenance crews will be on site. In the schedule provide a contact person and emergency phone number.

D. The Maintenance Period shall be extended, when in the opinion of the College's Representative, dead or dying plant materials, poor or unhealthy growing conditions, or improper maintenance practices are evident within the maintenance period. The extended period shall be provided at no additional cost to the Owner, and shall be extended until the work is complete and acceptable to the College's Representative.

E. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas

1. Watering: Keep lawn uniformly moist to a depth of 4 inches. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.

2. Water lawn at a minimum rate of 1 inch per week.

3. Watering: Keep seeding uniformly moist. If a permanent irrigation of ½" per week for 8 weeks after planting or per the seed supplier's recommendations.

F. Mow lawn only after sufficient root growth has been established in order to withstand any damage from maintenance foot traffic, equipment and other exposures typical of turf maintenance and top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do

not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Paspalum: 3/8”-1” with a Reel mower.

G. Lawn Post fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb./1000 sq. ft. to lawn area.

1.10 REJECTION AND SUBSTITUTION

A. Products or materials, whether installed or not, not conforming to the requirements herein specified shall be considered defective, and be marked as rejected. Materials shall be removed and replaced with approved materials at no additional cost to the Owner.

B. Submit written request for each proposed substitution. Provide data substantiating request as well as a “Certificate of Suitability” certifying that the proposed substitution is equal or better in all respects to that specified and that it will, in all respects perform the function for which it is intended. Include with request all required samples. Submit 3 copies of all written requests and data for proposed substitution.

1.11 SITE OBSERVATIONS

A. Schedule and coordinate site observation visits for the following construction activities. Reviews shall be performed by the College’s Representative and notification shall be given in advance as noted:

Item	Advance Notice
1. Protection of existing plant materials	48 hours
2. Rough grade and soil tests	48 hours
3. Soil preparation and finish grade	8 hours
4. Percolation tests	48 hours
5. Plant material review	48 hours
6. Plant layout and installation	48 hours
7. Substantial Completion Punch List	7 days
8. Punch List Completion	7 days
9. (Authorized start of Maintenance Period)	
10. Maintenance Completion	7 days

1.12 TEMPORARY UTILITIES

A. Provide all temporary piping, wiring, meters, panels and other related appurtenances required between the source of supply and the point of use of utilities.

1. Permission to shut off in-use utilities must be obtained 48 hours in advance, in writing from the College's Representative. The College's Representative shall determine the length of time for each shut-off.

PART 2 - PRODUCTS

2.1 GENERAL

A. Plants shall be in accordance with the California State Regulations for Nursery Inspection of Rules and Grading. All plants shall have a normal habit of growth and shall be sound, healthy and vigorous.

B. Soil Amendments: An assumed median level of amendments, including Gypsum, Soil Sulfur, Iron Sulfate and Organic Soil Amendment, must be specified for bidding purposes and adjusted as a result of final soil analysis during construction.

C. Fertilizing: All planting areas shall be fertilized. Incorporate fertilizer with soil amendments based on soil analysis.

2.2 TURFGRASS SOD

A. Sod shall be Platinum TE Paspalum. Contractor shall verify with the supplier, that the sod type and quantity will be available at time of installation. Substitution will not be considered after acceptance of submittals.

B. Sod shall be machine cut at a uniform soil thickness of 5/8 inch plus or minus 1/4 inch. 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 percent. 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 percent of the section.

C. 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 reviewed prior to installation and accepted by the Architect. Sod shall not be harvested or transplanted when moisture content may adversely affect handling and installation.

2.3 INORGANIC SOIL AMENDMENTS

A. Soil Sulfur: A commercially processed and packaged product in elemental form (S) Sulfur 90%, capable of oxidizing over time and providing nutrient sulfur. Pelletized.

B. Iron Sulfate: A non-staining iron with micronutrients, pelletized, slow release, environmentally safe, 40% Iron, 1% Manganese, 1% Zinc, 1% Magnesium, 6% Sulfur, 2% Humic Acids.

C. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate. Ninety percent shall pass a 50 mesh screen.

2.4 SOIL AMENDMENTS

A. Soil Amendment/Conditioner: An organic, sustainably sourced product made from plant trimmings supplying slow release primary minerals of Nitrogen, Phosphate, Potash. Shall not contain poultry, animal or human waste. Finished product screened through 3/8" mesh and have a moisture content of 25%. "Humic Compost" by Agri Service (800) 262-4167.

B. Iron Sulfate: a commercially processed and packaged product (FeSO4 H2O) Ferrous Sulphate Monohydrate - 95.7%. Ninety percent passing a 50 mesh screen. (Per soils lab analysis).

C. Sulfur: a commercially processed and packaged product in elemental form (S) Sulfur - 95.0%, capable of oxidizing over time and providing nutrient sulfur. Pelletized. (Per soils lab analysis).

2.5 FERTILIZER

A. Pre-plant Fertilizer: Starter Fertilizer for lawns and grasses with an analysis of 6-20-20swith Soil Penetrant Added. Fertilizer and soil conditioner derived from organic materials consisting of higher plant form life, composted beyond the fibrous stage. Shall not contain any of the following: poultry, animal or human waste, pathogenic viruses, fly larvae, insecticides, herbicides, fungicides or poisonous chemicals that would inhibit plant growth. Physical properties: A uniform "Beaded" homogenous mixture - 100.00% passing through a #4 mesh screen - a water soluble bio-degradable binder is used to insure fast breakdown. Such as “Gro-Power Plus 5-3-1” as manufactured by Gro-Power®, Inc. (909)393-3744, or approved equal

Chemical Analysis: 8-2-4, nitrogen 8.00%, phosphate 2.00%, soluble potash 4.00%, Calcium

Nitrogen	5% minimum
Phosphoric Acid	3% minimum
Water Soluble Potash	1% minimum
Humus	70% minimum
Humic Acids	5% minimum
Soluble Metallic Iron	1% minimum

Soil Penetrant: (Alkyl Naphthalene Sodium Sulfonate)

1% minimum

Bacterial "stimulator": (Common soil and airborne organisms - aerobic, anaerobic, yeast and mold)

60,000 per 100-gram minimum

B. Post-plant Fertilizer: Controlled release blend of methylene ureas, phosphorus, Potash and trace minerals. Humus and humic acids are added to aid the plant to assimilate necessary nutrients. Not dependent on bacterial breakdown. As manufactured by Gro-Power®, Inc. (909)393-3744, no known equal.

Chemical analysis: 12-8-8, nitrogen 12.00%, phosphate 8.00%, soluble potash 8.00%, calcium

Nitrogen	12% minimum
Phosphoric acid	8% minimum
Soluble potash	8% minimum

C. Soil Conditioner plus Calcium: JTM Nutrients 'Activator Ca' Fertilizer and soil conditioner derived from magnetic rock, and rock phosphate. 10% Humic acid as derived from humic shale ore. Shall not contain poultry, animal or human waste. As manufactured by JTM Nutrients® (949) 632-7378, no known equal.

Chemical Analysis: 0-5.5-0 (7%) Ca, phosphate 4.00%, Calcium 7.00%, Iron 1.00%.

Phosphate	4% minimum
Calcium	7% minimum
Iron	1% minimum

D. Soil Conditioner: Mycorrhizal Inoculum / Soil Conditioner: Inoculum shall be both Endo and Ecto (granular), with consisting of propagules (spores, fragments of fungal mycelium, and pieces of mycorrhizal roots capable of colonizing host plant roots) of the vesicular arbuscular mycorrhizal species Glomus intraradices, Glomus aggregatum, Glomus mosseae, combined with other species and/or additional genera including, Sclerocyctis, Gigaspora, Scutellospora, Entrophospora, and Acaulospora. Ectomycorrhiza include Pisolithus and 4 species of Rhizopogon. Soil Conditioner portion shall consist of organic materials consisting of higher plant form life, composted beyond the fibrous stage, to humus. Also shall have humic acids and beneficial soil bacteria strains. It shall NOT contain poultry, animal or human waste (i.e., sewage sludge), pathogenic viruses, fly larvae, insecticides, herbicides, fungicide or poisonous chemicals that would inhibit plant growth. Shall be “GroLife” (800) 473-1307, to match existing. This is a necessary item, that is only available from the listed source, and no other product shall be furnished.

Ingredients	percentage (minimum)
1. Mycorrhizal Inoculum	6,500/55,000 propagules per lb.*
2. Humus	65%
3. Humic Acid	25%

2.6 BARRICADE MATERIALS

A. Protective Enclosure: “Temporary” construction fence 6’ tall chain link fence with a minimum 1½” dia. posts and 1” top and bottom rails.

B. 36" high orange snow fence w/ metal stakes or approved equal.

C. Caution tape, or twine and flags are not acceptable.

2.7 MISCELLANEOUS PRODUCTS

A. Prior to using herbicides, contractor shall review procedures with the College’s Representative and obtain written approval. A contractor licensed by the department of Pesticide Regulation (DPR) with an active Qualified Applicator’s Certificate (QAC) or a Qualified Applicator’s License (QAL) only shall perform herbicide applications. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

B. Pre-emergent herbicide shall be Treflan, Surfland, Eptan, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Finish Grading: All grades shall be finished graded. Finish grades shall be coordinated with adjacent finish paving and finish surfaces.

B. Rototilling/ripping: Rip, recompact and amend native subgrade to a depth of 18 inches prior to placement of import sports field mix and/or amendments. Remove all rocks in the top 6 inches of amended subgrade. Mitigate compaction in planting areas due to staging or construction.

3.2 EXAMINATION

A. Examine areas to receive sod and seeding for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine areas to be planted before start of work, locate utilities, improvements, and easements, verify dimensions and areas shown on the Drawings with actual conditions identify and tag existing plant material to remain. Document conditions, which are in, direct conflict with the Drawings and notify the College's Representative. Do not start work until conditions that would adversely affect performance, installation, or quality of the work have been corrected. Start of work of this Section constitutes acceptance of the conditions.

3.3 WEED CONTROL

A. Prior to commencement of the planting operations, remove all weeds including the roots, remove existing plant material including stumps designated not to remain, dispose of cleared and grubbed material at a legal refuse site. Prior to using herbicides, review procedures with the Owner Representative, and obtain written approval. An operator licensed by the Department of pesticide Regulation (DPR) with an active Qualified Applicator's Certificate (QAC) or a Qualified Applicator's License (QAL) shall perform herbicide applications requiring government or agency approvals. Protect existing plant material on site and on adjacent properties from exposure to herbicides and equipment. 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.

3.4 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. 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.

3.5 SOIL PREPARATION

A. Limit lawn and seeding preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen existing subgrade to a minimum depth of 18 inches without adding soil conditioner. Remove stones, clods and debris larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off College's property provide positive drainage of subgrade prior to installation of sport field soil mix.

1. Spread soil conditioner, gypsum and other amendments over all planting areas indicated on the Drawings, and mechanically till and blend to a depth of 6 inches.

2. Rake smooth, lightly water, and compact to the finish grades shown on the Drawings. Use the amendments listed below for bidding purposes only. Materials and application rates may be modified after receipt of soils tests.

3. Use the amendments listed below for bidding purposes only. Modify materials and application rates after receipt of soils tests.

a. Soil Conditioner	6 cy./ 1000 sq.ft
b. Gypsum	100 lbs./ 1000 sq.ft.
c. Pre-Plant Fertilizer 5-3-1/	150 lbs./ 1000 sq.ft
d. Soil Sulfur	10 lbs./ 1000 sq.ft
e. Mycorrhizal Inoculum / Soil Conditioner	20 lbs./ 1000 sq.ft

4. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

5. Thoroughly blend planting soil mix off-site before spreading, apply soil amendments on surface, and thoroughly blend planting soil mix.

C. For Turfgrass only: Irrigate the area to thoroughly moisten soil and evenly broadcast the turf fertilizer (16-20-0) at the rate of one pound per 100 square feet, rake in lightly to a depth of 1”.

1. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

2. Remove stones larger than 1-inch in any dimension and sticks, roots, trash, and other extraneous matter.

3. Legally dispose of waste material, including grass, vegetation, and turf, off College’s property.

4. Rake smooth and roll the area to compact and expose soil depressions or surface irregularities. Re-grade as necessary to achieve the finish grades indicated on the Drawings less the depth of the sod.

5. Irrigate the area to thoroughly moisten soil and evenly broadcast the turf fertilizer (16-20-0) at the rate of one pound per 100 square feet, rake in lightly to a depth of 1”.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Float smooth and compact all soil preparation areas to 85% relative dry density, maintain positive drainage, flow lines, and swells to area drains, fine grade to within plus or minus 0.10 foot of the grades shown on the Drawings. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

E. Moisten prepared lawn and seeding areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.6 TURFGRASS SOD INSTALLATION

A. Soil Preparation -Rake smooth and roll the area to compact and expose soil depressions or surface irregularities. Re-grade as necessary to achieve the finish grades indicated on the

Drawings less the depth of the sod. Irrigate the area to thoroughly moisten soil and evenly broadcast the turf fertilizer (16-20-0) at the rate of one pound per 100 square feet, rake in lightly to a depth of 1”.

B. Installation: Place the first row of sod along a straight line. Butt joints tightly, do not overlap edges, and stagger the joints of succeeding rows. Use a sharp knife to cut the sod to fit curves, edges, around sprinkler heads, and other appurtenances. Water-in large areas to prevent drying, and continue to lay sod until installation is complete. After laying all sod, roll lightly to eliminate irregularities, and to form good contact between the sod and soil.

3.7 IRRIGATION

1. Irrigate areas throughout the construction and maintenance period, or until the planting is sufficiently well established as per College’s Representative's approval.

3.8 SATISFACTORY LAWNS

A. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

3.9 CLEANUP AND PROTECTION

A. As the work progresses, maintain areas in a neat, clean, orderly manner, and remove unsightly debris as necessary. At the completion of the work, sweep and clean all walks, parking and other paved areas adjacent to plantings.

B. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

C. Protect plants, lawns from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

D. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

E. Remove erosion-control measures after grass establishment period.

3.10 DISPOSAL

A. Disposal: All grubbed material, rock, surplus soil and waste material, including excess subsoil, unsuitable soil, trash and other debris shall be removed from the College’s property and disposed of in a legal disposal or recycling site.

3.11 MAINTENANCE

A. Maintenance of turf areas includes proper watering and soil moisture content, fertilizing, mulching, cutting, rolling, pest and disease control, reseeding and other functions necessary to maintain a healthy, vigorous growing lawn. Maintenance will continue until all lawn areas have a complete established close stand of grass.

B. Maintenance Schedules: Provide complete maintenance specifications including general design maintenance intent of plant material and fertilizing schedule based on planting design.

END OF SECTION

SECTION 329316
EXTERIOR PLANTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section Includes complete installation of landscape items as shown on the Drawings and as specified in this Section

B. Related Sections

1. 01 56 39 Tree and Plant Protection
2. 03 30 00 Cast-in-place Concrete
3. 31 10 00 Site Clearing
4. 31 22 00 Grading
5. 31 23 16 Excavation
6. 31 23 23 Fill: Compacted Subbase for Paving
7. 32 13 13 Concrete Paving
8. 32 13 16 Decorative Concrete Paving
9. 32 84 00 Landscape Irrigation
10. 32 93 13 Lawns and Grasses
11. 32 93 16 Exterior Plants
12. 33 41 11 Storm Utility Drainage Piping

1.2 GENERAL REQUIREMENTS/DEFINITIONS

A. The term "Planting Area" shall mean areas to be planted with trees, shrubs, groundcovers, lawn, or seed, or areas to be covered with various gravel or stone mulches not intended for pedestrian or vehicular circulation.

B. The term "Contract Close-out" shall mean the date at the close of the Maintenance Period when the work has been completed, checked, accepted, and written approval of the work has been given by the College’s Representative.

C. The term "Date of Acceptance" shall mean the date at the end of the warranty periods as specified herein, and written acceptance has been given by the College’s Representative.

D. Protect and maintain at all times the existing plant material identified on the Drawings as “to remain”.

E. Finish Grade: Elevation of finished surface of planting soil.

F. Import Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

G. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

H. Planter Pot Soil/Interior Plant Medium: Soil produced by blending a mixture of organics, sand and nutrients to be used as a growing medium for plants in pots located interior or exterior.

I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

J. Raised Planter: Planted areas that are bounded by any (1) wall 12” higher than adjacent grade or surface. To be filled with import topsoil to the full and complete depth of the planter.

1.3 SUBMITTALS

A. Submittals for above items shall be made in one package. If submittals are judged incomplete or non-responsive to the directions of the College’s Representative after three (3) submissions the Contractor shall be back charged for the College’s Representatives costs to process additional Submittals. Additional Submittal Procedures are specified in Section 01 33 00.

B. Product Data and Samples:

1. Soil amendments and fertilizers: Submit manufacturer’s product data on amendments and fertilizers as noted. Include brand names, estimated quantities, and supplier.

2. Plant materials: Submit a list of all plant materials with quantities, sizes, and source.

3. Shrubs: For each species, submit digital photograph of each plant 15-gallon size or larger, labeled with botanical name, container size, height, spread, and nursery source. Include an adult human figure in each photograph for scale. Photos shall be an accurate representation of the actual tree specimens to be utilized on the project. For species where more than 10 plants are required, include a minimum of three photographs of that species showing the average plant, the best quality plant, and the worst quality plant to be furnished.

4. Bark Mulches: Submit three (3) 1/4 lb. bagged samples of each specified material. Label bag with name, source, size, and color range.

5. Landscape products: Submit manufacturer’s product data for all landscape products specified below.

C. Soil Analysis: Soil analysis test reports shall be completed after rough grading to determine actual recommended soil amendments. Refer to Part 1: SOIL TESTING. Provide soil testing laboratory a copy of the 32 93 16 Exterior Plants Specification and Plant List with soil samples. Maintenance Instructions: Prepare instructions for maintenance in cooperation with the Owner for the Maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods. Instructions shall include but not be limited to the following tasks:

1. Fertilizing

2. Irrigation schedule

3. Dead heading

4. Mulch or other inert groundcover replenishment

5. Pruning of Shrubs to maintain design intent

6. 3 year tree maintenance schedule

D. As Built Drawings of Landscape Planting.

1.4 QUALITY ASSURANCE

A. Reference Standards: Reference Standards apply to this Sections and shall be the latest edition of the following:

1. "A Checklist of Woody Ornamental Plants of California", Owner of California, College of Agriculture

2. ANSI Z60.1 American Standards for Nursery Stock

3. “Seed Laws” State of California Department of Foo d and Agriculture

4. “Seed Laws” U.S. Department of Agriculture

5. Hortus Third

6. Sunset Western Garden Book, Sunset Publishing Corporation

B. Landscaping Contractor

1. Installer Qualifications: All of the work required to be provided as described in this Section of the Specifications shall be provided by a sub-contractor skilled in this specialty, holding a valid C-27 California contractor's license.

2. The qualified landscape installer shall exhibit work that has resulted in exterior plants establishment. Submitted qualifications shall include a client list with contact names, phone numbers and date exterior planting was installed. Submitted qualifications shall include a client list with contact names, phone numbers and date California Native Plant Landscapes were installed.

3. All work shall be performed by a trained crew in accordance with the standards and practices related to the trade.

4. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.

5. This full-time supervisor must possess a current Certified Landscape Technician (CLT) certificate with the California Landscape Contractors Association (CLCA), and is to be present at all times during execution of this portion of the work and who is thoroughly familiar with the methods of installation and who is to direct all work performed under this section.

6. Provide photocopies of the current CLT registration for all foreman performing work on this project.

1.5 WARRANTY AND REPLACEMENTS

A. Submit written warranties on the Contractor's or subcontractor's letterhead, addressed to the Owner. Submit all warranties in duplicate and in the form shown in the General Conditions, or modified as approved to suit the conditions pertaining to the warranty.

B. Trees shall be warranted to remain healthy and in a vigorous growing condition for a period of one year from Contract Close-out.

C. Shrubs, vines and groundcovers shall be warranted to remain healthy and in a vigorous growing condition for a period of six months from Contract Close-out.

D. Palm trees shall be warranted to remain healthy and in a vigorous growing condition for a period of two years from Contract Close-out.

E. Plants found dead or not in a vigorous growing condition during the Warranty Period shall be removed and replaced within 14 days of written notification by the College's Representative. Replacement plants shall be of the same size, species and variety as specified. Replacement includes restoration of surrounding area to match the existing conditions. All work shall be provided at no additional expense to the Owner.

1.6 REJECTION AND SUBSTITUTION

A. Products or materials, whether installed or not, not conforming to the requirements herein specified shall be considered defective, and be marked as rejected. Materials shall be removed and replaced with approved materials at no additional cost to the Owner.

B. Submit written request for each proposed substitution. Provide data substantiating request as well as a "Certificate of Suitability" certifying that the proposed substitution is equal or better in all respects to that specified and that it will, in all respects perform the function for which it is intended. Include with request all required samples. Submit 3 copies of all written requests and data for proposed substitution.

1.7 SITE OBSERVATIONS

A. Schedule and coordinate site observation visits for the following construction activities. Reviews shall be performed by the College's Representative and notification shall be given in advance as noted: Item Advance Notice

1.	Protection of existing plant materials	48 hours
2.	Rough grade and soil tests	48 hours
3.	Plant material	48 hours
4.	Soil preparation and finish grade	48 hours
5.	Percolation tests	48 hours
6.	Plant layout and installation	48 hours
7.	Substantial Completion Punch List	7 days
8.	Punch List Completion (Authorize start of Maintenance Period)	7 days

9. Maintenance Completion 7 days

B. Site observations and acceptance will be documented in writing by the College's Representative. No site observations shall commence without items noted in previous reports being completed, remedied, or waived by the Owner. If Contractor is not prepared for a scheduled site observation the Contractor shall be back charged for the costs incurred by the College's Representative.

1.8 MAINTENANCE

A. The Maintenance Period begins on the first day after all work has been reviewed and accepted in writing by the College's Representative. The College's Representative shall determine the start date, and the Period shall continue thereafter for 90 continuous calendar days.

B. Within one week of receipt of the written notice, submit a Maintenance Schedule to the College's Representative listing the days when maintenance crews will be on site, include in the schedule, a contact person and emergency phone number.

C. Maintenance includes weeding, watering, fertilizing, pruning, trimming, mowing, pest and disease control, water monitoring, re-staking/ guying, mulching, clean-up and other operations required to establish a healthy growing condition.

D. The Maintenance Period shall be extended, when in the opinion of the College's Representative, dead or dying plant materials, poor or unhealthy growing conditions, or improper maintenance practices are evident at the close of the Period. The extended period shall be provided at no additional cost to the Owner, and shall be extended until the work is complete and acceptable to the College's Representative.

1.9 TEMPORARY UTILITIES

A. Provide all temporary piping, wiring, meters, panels and other related appurtenances required between the source of supply and the point of use of utilities.

B. Permission to shut off in-use utilities must be obtained 48 hours in advance, in writing from the College's Representative. The College's Representative shall determine the length of time for each shut-off.

1.10 SOIL TESTING

A. Qualifications

1. Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

B. Supply Soil Testing Laboratory with complete copy of 32 93 16 Specification Section and Plant List at time of soil tests. Soil amendment recommendations from soil laboratory shall be based on the submitted products in this specification when possible.

C. Soil Testing After Rough Grading

1. At the conclusion of rough grading, collect soil samples per planting plan with key map indicating soil sample number, and submit the samples to an agricultural soils laboratory for testing. Submit the test results to the College's Representative for review. No amendments shall be applied prior to receipt of test results. The College's Representative shall recommend changes to the amendments and/or procedure listed herein, after

review of the test results. Costs for testing shall be included in the base bid. Cost change for soil preparation work shall be in accordance with the provisions of the General Conditions.

2. A soil analysis shall be made after rough grading operations are complete to determine actual recommended soil amendments.

3. Soil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter, textural test, textural classification, silt sand clay content; sodium absorption rate (SAR), electrical conductivity (ECe), cation exchange capacity; boron content, deleterious material; pH; mineral and plant-nutrient content of topsoil and elemental data, corrective recommendations and soil amendment recommendations.

4. Report suitability of soil for plant growth. State recommended quantities of amendments and soil amendments to be added to produce satisfactory planting soil. Testing agency must use amendments listed in this specification in their recommendations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Label each plant group with full botanical name, species, and varieties on weatherproof tags attached securely to the plant before delivery to the site. Provide a minimum of one labeled plant for each five (5) plants in a group.

B. Plants shall have a normal growth habit, be sound, healthy, vigorous and free from insect pests, insect eggs, plant diseases, sun scalds, fresh bark abrasions, excessive disfigurements, and meet or exceed the measurements specified. Trunks shall be sturdy and well "hardened-off". Plants shall have normal well-developed, vigorous and fibrous root systems which are neither root, nor container-bound, are free of kinked or girdling roots. Plants shall have grown in their containers for at least six months, but not over two years. Plants that have cracked or broken rootballs shall be replaced with the same species, size, and character as specified.

C. Groundcover plants shall be healthy vigorous rooted cuttings grown in flats for at least three months, but not over six months.

D. Succulents: Shall be acquired from a licensed nursery. Provide the nursery suppliers to the College’s Representative. Succulents shall be free of insects, mottled leaves, broken or split branches or trunks, scarring or any other uncharacteristic growth patterns.

E. Obtain inspections, and secure permits or certificates required by City, County, or State authorities prior to delivery to the site. No plant material may be delivered to the site that is located within a Department of Agriculture quarantined zone.

F. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, stunted and disfigurement. Plants shall have normal well-developed, vigorous and fibrous root systems which are neither root, nor container-bound, are free of kinked or girdling roots.

G. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to College’s Representative, with a proportionate increase in size of roots or balls.

2.2 SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, stunted and disfigurement. Plants shall have normal well-developed, vigorous and fibrous root systems which are neither root, nor container-bound, are free of kinked or girdling roots. Trunk caliper and taper shall be sufficient so that the lower five feet of the trunk remains vertical without a stake. Auxiliary stake may be used to maintain a straight leader in the upper half of the tree.

B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to College's Representative, with a proportionate increase in size of roots or balls.

C. Label at least five shrubs of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

D. Obtain inspections, and secure permits or certificates required by authorities having jurisdiction prior to delivery.

2.3 TREES

No new trees are specified for this Project. Refer to Section 01 56 39 Tree Protection for preservation of existing trees on site.

2.4 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum height and spread specified in the drawings or required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

2.5 CALIFORNIA NATIVE PLANTING

A. Form and Size: California Native Planting with not less than the minimum height and spread specified in the drawings or required by and measured according to ANSI Z60.1 for type, shape, and height of California Native Planting.

2.6 GROUND COVER PLANTS

A. Ground Cover: Provide ground cover of species indicated, established and well rooted in flats, pots or similar containers, and complying with ANSI Z60.1

B. Groundcover plants shall be healthy vigorous rooted cuttings grown in containers for at least three months, but not over six months.

2.7 SOIL AMENDMENT AND FERTILIZER

A. Organic Soil Amendment/Conditioner: An organic, sustainably sourced product made from plant trimmings supplying slow release primary minerals of Nitrogen, Phosphate, Potash. Shall not contain poultry, animal or human waste. Finished product screened through 3/8" mesh and have a moisture content of 25%. "Humic Compost" by Agri Service (800) 262-4167, or approved equal.

B. Gypsum: a commercially processed and packaged gypsum (CaSo4, H2O) Calcium Sulfate Product - 94.3%. Ninety percent shall pass a 50 mesh screen, (per soils lab analysis).

C. Iron Sulfate: a commercially processed and packaged product (FeSO4 H2O) Ferrous Sulphate Monohydrate - 95.7%. Ninety percent passing a 50 mesh screen, (per soils lab analysis).

D. Sulfur: a commercially processed and packaged product in elemental form (S) Sulfur - 95.0%, capable of oxidizing over time and providing nutrient sulfur. Pelletized (per soils lab analysis).

E. Pre-plant Fertilizer: Pre-plant Fertilizer for plants (5-3-1) with Soil Penetrant Added. Fertilizer and soil conditioner derived from organic materials consisting of higher plant form life, composted beyond the fibrous stage. Shall not contain any of the following: poultry, animal or human waste, pathogenic viruses, fly larvae, insecticides, herbicides, fungicides or poisonous chemicals that would inhibit plant growth. Physical properties: A uniform "Beaded" homogenous mixture - 100.00% passing through a #4 mesh screen - a water soluble bio-degradable binder is used to insure fast breakdown. Such as “Gro-Power Plus 5-3-1” as manufactured by Gro-Power®, Inc. (909)393-3744, or approved equal.

Nitrogen	5% minimum
Phosphoric Acid	3% minimum
Water Soluble Potash	1% minimum
Humus	70% minimum
Humic Acids	15% minimum
Soluble Metallic Iron	1% minimum
Soil Penetrant: (Alkyl Naphthalene Sodium Sulfonate)	1% minimum
Bacterial "stimulator": (Common soil and airborne organisms - aerobic, anaerobic, yeast and mold)	60,000 per 100 gram minimum

F. Post-plant Fertilizer: Controlled release blend of methylene ureas, phosphorus, Potash and trace minerals. Humus and humic acids are added to aid the plant to assimilate necessary nutrients. Not dependent on bacterial breakdown. As manufactured by Gro-Power®, Inc. (909)393-3744, no known equal.

Chemical analysis: 12-8-8, nitrogen 12.00%, phosphate 8.00%, soluble potash 8.00%, calcium

Nitrogen	12% minimum
Phosphoric acid	8% minimum
Soluble potash	8% minimum

G. Mineral Soil Conditioner plus Calcium: JTM Nutrients 'Activator Ca' Fertilizer and soil conditioner derived from magnetic rock, and rock phosphate. 10% humic acid as derived from humic shale ore. Shall not contain poultry, animal or human waste. As manufactured by JTM Nutrients® (949) 632-7378, no known equal.

Chemical Analysis: 0-5.5-0 (7%) Ca, phosphate 4.00%, Calcium 7.00%, Iron 1.00%.

Phosphate	4% minimum
Calcium	7% minimum

Iron	1% minimum

H. Mycorrhizal Soil Conditioner: Mycorrhizal Inoculum shall be both Endo and Ecto (granular), with consisting of propagules (spores, fragments of fungal mycelium, and pieces of mycorrhizal roots capable of colonizing host plant roots) of the vesicular arbuscular mycorrhizal species Glomus intraradices, Glomus aggregatum, Glomus mosseae, combined with other species and/or additional genera including, Sclerocyctis, Gigaspora, Scutellospora, Entrophospora, and Acaulospora. Ectomycorrhiza include Pisolithus and 4 species of Rhizopogon. Soil Conditioner portion shall consist of organic materials consisting of higher plant form life, composted beyond the fibrous stage, to humus. Also shall have humic acids and beneficial soil bacteria strains. It shall NOT contain poultry, animal or human waste (i.e., sewage sludge), pathogenic viruses, fly larvae, insecticides, herbicides, fungicide or poisonous chemicals that would inhibit plant growth. Shall be “Myco Pak” Inoculum as manufactured by Tri-C Enterprises, Inc. (909) 590-1790 – no known equal.

I. Planting Tablets: Tightly compressed chip type commercial grade planting tablets, and containing the following available percentages by weight of plant food, slow release fertilizer tablets, soil conditioner, and 24-month formulation with trace elements, composted organic higher plant form life and mineral matter. Shall not contain any poultry, animal or human waste. Such as “Gro-Power Planting Tablets (20-10-5)” as manufactured by Gro-Power®, Inc. (909)393-3744, no known equal:

Nitrogen	20% minimum
Phosphoric Acid	10% minimum
Potash	05% minimum

2.8 IMPORT TOPSOIL

A. Provide soils test on proposed import soil for suitability review prior to delivery to the site.

B. Import topsoil also to be used on-grade as required for fill operations or as specified in the drawings.

C. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing the 2.0 millimeter sieve. The sodium absorption rate (SAR) shall not exceed 6 and the electrical conductivity (ECe) of the saturation extract of this soil shall not exceed 3.0 milliohms per centimeter at 25 degrees centigrade. The boron content shall be no greater than 1 part per million as measured on the saturation extract. Submit results of agricultural soils analysis for review and approval by the College’s Representative.

D. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 2 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

2.9 MULCH

A. Bark Mulch: (All planting except lawn/turf) Forest Fines, as supplied by Agri-Service and 760.214.1842.

PART 3 - EXECUTION

3.1 GENERAL

A. Rip and Re-compact: Rip and re-compact sub-grade in all on grade planting areas to a depth of 18 inches or as indicated in the Drawings prior to placement of amendments and prior to the installation of any irrigation lines. Remove all rocks in the top 6 inches. Mitigate compaction in planting areas due to staging or construction.

B. Finish Grading: All grades shall be finished graded prior to the commencement of planting operations. Finish grades shall be coordinated with adjacent finish paving and finish surfaces.

3.2 EXAMINATION

A. Examine areas to be planted before start of work, locate utilities, improvements, and easements, verify dimensions and areas shown on the Drawings with actual conditions, identify and tag existing plant material to remain. Document conditions which are in direct conflict with the Drawings and notify the College's Representative. Do not start work until conditions that would adversely affect performance, installation, or quality of the work has been corrected. Start of work of this Section constitutes acceptance of the conditions.

3.3 WEED CONTROL

A. Prior to commencement of the planting operations, remove all weeds including the roots, remove existing plant material including stumps designated not to remain, dispose of cleared and grubbed material at a legal refuse site.

B. Prior to using herbicides, review procedures with the College's Representative, and obtain written approval. Herbicide applications requiring government or agency approvals shall be performed by an operator licensed by the County.

C. Protect existing plant material on site and on adjacent properties from exposure to herbicides and equipment.

3.4 SOILS TESTS

A. At the conclusion of rough grading, collect soil samples as indicated on Drawings, and submit the samples to an agricultural soils laboratory for testing along with a copy of the 32 93 16 Exterior Plants Specification and a plant list. Soil amendment recommendations from soil laboratory shall be based on the submitted products in this specification when possible. Submit the test results to the College's Representative for review. No amendments shall be applied prior to receipt of test results. The College's Representative shall recommend changes to the amendments and/or procedure listed herein, after review of the test results. Costs for testing shall be included in the base bid. Cost change for soil preparation work shall be in accordance with the provisions of the General Conditions.

3.5 SOIL PREPARATION AND FINISH GRADES

A. Spread amendments over all planting areas indicated on the Drawings, and mechanically till and blend to a depth of six (6) inches. Prepare areas within the dripline of existing trees by hand, do not use mechanical tillers. Remove foreign material, construction debris, and rocks larger than 2" in diameter. Rake smooth, lightly water, and compact to the finish grades shown on the Drawings. Use the amendments listed below for bidding purposes only. Materials and application rates may be modified after receipt of soils tests noted in item 3.04.

Amendments	Rate or Quantity/1,000 s.f.
1. Organic Soil Conditioner	4 cu. yds.

2. Nutrient Soil Conditioner plus Calcium 150 lbs.
3. Gypsum 10 lbs.
4. Soil Sulfur 10 lbs.
5. Pre-Plant Fertilizer 20 lbs.

B. Float smooth and compact all soil preparation areas to 85% relative dry density, maintain positive drainage, flow lines, and swells to area drains, fine grade to within plus or minus 0.10 foot of the grades shown on the Drawings.

3.6 PERCOLATION TESTS

A. Locate and prepare the percolation test pits where indicated on the Drawings (# locations), and as described herein.

B. Excavate the pits as describe under the plant installation section, remove all loose material, and fill the pits with six inches (6") of water. After 12 hours refill with the same amount of water. Six hours after the second filling, inspect the pits with the College's Representative and document locations where water remains in the pit.

C. If percolation problems occur, provide means and methods for correcting said problems. Planting operations at the locations identified shall be suspended as necessary or as directed by the College's Representative. Payment for corrective work shall be in accordance with the provisions of the General Conditions. Proceeding with the work without written approval, does not entitle the Contractor to additional compensation for corrective work.

3.7 SHRUB PLANTING

A. Shrub Planting:

1. Dig holes for shrubs and vines a minimum 3 times greater than the rootball.
2. Typical minimum distance from shrub to edge of walks is one-half mature width. See Plant Legend for required offsets from paving.

B. Placement: Center each tree, shrub or vine, set plumb, and hold rigidly in position until the planting backfill work is complete. Prior to backfilling, check for girdling or kinked roots, and correct the conditions according to accepted nursery practice. Set plants at a level that after settling results in the root crown to finish grade relationship shown on the Drawings and Details. Specimen plants in 36" box size or larger shall be placed, positioned, and set with a crane.

C. Backfill and Compaction: Place backfill in maximum 6 inch layers. Compact to 85% relative dry density prior to placement of each succeeding layer in planting areas. At completion of the planting operation, thoroughly water-in each plant to the full depth of the plant pit. Use the amendments listed below for bidding purposes only. Materials and application rates may be modified after receipt of soils tests noted in item 3.04.

1. Backfill mixture for all plants shall be thoroughly blended, consisting of the following:

1. Existing Soil 4 parts
2. Gypsum 25 lbs./CY of mix

3. Iron Sulfate	2 lbs./CY of mix
4. Soil Sulfur	1 lb./CY of mix
5. *Organic Soil Conditioner	15 lb./CY (Incorporate in only the top 18" layer.)
6. *Pre-plant Fertilizer (8-2-4)	30 lb./CY of mix (Incorporate in only the top 18" layer.)
7. **Mycorrhizal Soil Conditioner	10 lb./CY of mix
8. 'Superthrive' Vitamin Solution	2Tbsp/per 5 gal. water

3.8 CALIFORNIA NATIVE PLANTING

A. Dig holes for California Native Planting a minimum 2 times greater than the rootball.

B. Typical minimum distance from shrub to edge of walks is one-half mature width.

C. Placement: Center each shrub, set plumb, and hold rigidly in position until the planting backfill work is complete. Prior to backfilling, check for girdling or kinked roots, and correct the conditions according to accepted nursery practice. Set plants at a level that after settling results in the root crown to finish grade relationship shown on the Drawings.

D. Backfill and Compaction: Place backfill in maximum 6 inch layers. Compact to 85% relative dry density prior to placement of each succeeding layer in planting areas. At completion of the planting operation, thoroughly water-in each plant to the full depth of the plant pit. Use the amendments listed below for bidding purposes only. Materials and application rates may be modified after receipt of soils tests noted in item 3.04.

1. Backfill mixture for all California Native Plants shall be thoroughly blended, consisting of the following:

1. Existing Soil	4 parts
2. Organic Soil Conditioner	1 part
3. Mycorrhizal Inoculum / Soil Conditioner	10 lbs./ cu. yard of mix
4. Soil Conditioner plus Calcium	30 lbs./ cu. yard of mix

3.9 GROUNDCOVERS INSTALLATION

A. Prior to planting, check soil moisture for acceptable levels and lightly irrigate area as necessary, do not install plants in dry soil. Install plants in staggered rows and evenly spaced at the intervals indicated on the drawings. Excavate plant pits slightly larger than the rootball and place a 5 gram plant tablet in each pit, set plants to cover all roots, backfill, tamp, and rake area smooth.

B. As each planting area is completed, thoroughly water-in the area to the full depth of planting pits.

3.10 PLANTING TABLETS

A. Place planting tablets in all planting pits at the following rates:

Plant Size	Quantity	Tablet Size
Liner and flat size plant	1	5 gram
1 gallon container	1	21 gram
5 gallon container	2	21 gram
15 gallon container	3	21 gram

3.11 PLANTING TABLETS

A. Place myco-paks in all planting pits at the following rates:

Plant Size	Quantity
Liner and flat size plant	½ pak
1 gallon container	1 pak
5 gallon container	3 paks
15 gallon container	8 paks

3.12 POST-PLANT FERTILIZERS

A. Controlled release fertilizers shall be applied according to the manufacturer's instructions and standard horticultural practices.

3.13 MULCH APPLICATION

A. Bark Mulch: At the completion of the planting work, rake smooth the areas indicated on the Drawings, and spread a 3" layer of bark over the areas, taper to adjacent paving. Arrange mulch so as to not allow any visible grade showing.

B. Lift all leaves, low hanging stems and other green portions of small plants out of mulch if covered.

3.14 CLEAN-UP

A. As the work progresses, maintain areas in a neat, clean, orderly manner, and remove unsightly debris as necessary. At the completion of the work, sweep and clean all walks, parking, and other paved areas adjacent to plantings.

B. Remove and dispose of all tags, flagging materials are removed from plant material and accessories.

C. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.15 PROTECTION DURING CONSTRUCTION

A. The Contractor shall protect planting and related work and other site work from damage due to planting operations, operations by other Contractors or trespassers. Maintain protection during

installation until Substantial Completion Acceptance. Treat, repair or replace damaged work immediately.

B. Damage done by the contractor, or any of their sub-contractors to existing or installed plants, or any other parts of the work or existing features to remain, including roots, trunk or branches of large existing trees, soil, paving, utilities, lighting, irrigation, other finished work and surfaces including those on adjacent property, shall be cleaned, repaired or replaced by the contractor at no expense to the owner. The college's representative shall determine when such cleaning, replacement or repair is satisfactory.

3.16 DISPOSAL

A. Disposal: All grubbed material, rock, surplus soil and waste material, including excess subsoil, unsuitable soil, nursery pots and containers, tree boxes trash and other debris shall be removed from the College's property and disposed of or recycled in a legal disposal site.

3.17 SUBSTANTIAL COMPLETION ACCEPTANCE

A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.

1. Notification shall be at least 7 days prior to the date the contractor is requesting the review.

B. The date of substantial completion of the planting shall be the date when the College's Representative accept that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

C. The Plant Warranty period begins a date of written notification of substantial completion from the College's Representative. The date of substantial completion may be different than the date of substantial completion for the other sections of the project.

3.18 MAINTENANCE

A. General Plant Material: During the warranty period, provide maintenance, every two weeks minimum, for all plantings to keep the plants in a healthy state and the planting areas clean and neat based upon plant design.

B. General requirements:

1. All work shall be undertaken by trained planting crews under the supervision of a foreman with a minimum of 5 years' experience supervising commercial plant maintenance crews.

2. All chemical and fertilizer applications shall be made by licensed applicators for the type of chemicals to be used. All work and chemical use shall comply with all applicable local, provincial and federal requirements.

3. Assure that hoses and watering equipment and other maintenance equipment does not block paths or be placed in a manner that may create tripping hazards. Use standard safety warning barriers and other procedures to maintain the site in a safe manner for visitors at all times.

4. All workers shall wear required safety equipment and apparel appropriate for the tasks being undertaken.

5. The Contractor shall not store maintenance equipment at the site at times when they are not in use unless authorized in writing by the College's Representative.

6. Maintenance vehicles shall not park on the site including walks and lawn areas at any time without the College's Representative's written permission.

7. All contractor vehicles shall have signed placard located on the dashboard when accessing campus interior.

8. Maintain a detailed log of all maintenance activities including types of tasks, date of task, types and quantities of materials and products used, watering times and amounts, and number of each crew. Periodically review the logs with the College's Representative, and submit a copy of the logs at the end of each year of the maintenance agreement.

9. Meet with the College's Representative a minimum of three times a year to review the progress and discuss any changes that are needed in the maintenance program. At the end of the warranty period attend a hand over meeting to formally transfer the responsibilities of maintenance to the College's Representative. Provide all information on past maintenance activities and provide a list of critical tasks that will be needed over the next 12 months. Provide all maintenance logs and soil test data. Make the Contractor's supervisor available for a minimum of one year after the end of the warranty period to answer questions about past maintenance.

C. Provide the following maintenance tasks:

1. Watering: Provide all water required to keep soil within and around the root balls at optimum moisture content for plant growth.

    a. Maintain all watering systems and equipment and keep them operational.

    b. Monitor soil moisture to provide sufficient water. Check soil moisture and root ball moisture with a soil moisture meter on a regular basis and record moisture readings. Do not over water.

2. Soil nutrient levels: Take a minimum of 4 soil samples from around the site in the spring and fall and have them tested by an accredited agricultural soil testing lab for chemical composition of plant required nutrients, pH, salt and % organic matter. Test results shall include laboratory recommendations for nutrient applications. Apply fertilizers at rates recommended by the soil test.

    a. Make any other soil test and/or plant tissue test that may be indicated by plant conditions that may not be related to soil nutrient levels such as soil contaminated by other chemicals or lack of chemical uptake by the plant.

3. Plant pruning: Remove cross over branching, shorten or remove developing co-dominant leaders, dead wood and winter-damaged branches. Unless directed by the College's Representative, do not shear plants or make heading cuts.

4. Restore plants: Reset any plants that have settled or are leaning as soon as the condition is noticed.

5. Guying and staking: Maintain plant guys in a taught position. Remove tree guys and staking after the first full growing season unless directed by College's Representative.

6. Weed control: Keep all beds free of weeds. Hand-remove all weeds and any plants that do not appear on the planting plan. Chemical weed control is permitted only with the approval of the College's Representative. Schedule weeding as needed but not less 12 times per year.

7. Trash removal: Remove all trash and debris from all planting beds and maintain the beds in a neat and tidy appearance. The number of trash and debris removal visits shall be no less than 12 times per year and may coincide with other maintenance visits.

8. Plant pest control: Maintain disease, insects and other pests at manageable levels. Manageable levels shall be defined as damage to plants that may be noticeable to a professional but not to the average person. Use least invasive methods to control plant disease and insect outbreaks.

9. Plant replacement: Replace all plants that are defective as defined in the warranty provisions, as soon as the plant decline is obvious and in suitable weather and season for planting as outlined in above sections. Plants that become defective during the maintenance period shall be covered and replaced under the warranty provisions.

10. Mulch: Refresh mulch once a year to maintain complete coverage of 3 inches, but do not over mulch. At no time shall the overall mulch thickness be greater than 4 inches. Do not apply mulch within 6 inches of the trunks or stems of any plants. Replacement mulch shall meet the requirements of the original approved material. Mulch shall be no more than one inch on top of the root ball surface. and need to keep the mulch in the beds. Often after bed foliage completely fills in, no or little additional mulch is needed.

11. Bed edging: Check and maintain edges between mulch and lawn areas in smooth neat lines as originally shown on the drawings.

12. Leaf, fruit and other plant debris removal: Remove fall leaf, spent flowers, fruit and plant part accumulations from beds and paved surfaces. Maintain all surface water drains free of debris. Debris removal shall be undertaken at each visit to weed or pick up trash in beds.

13. Damage from site use: Repair of damage by site visitors and events, beyond normal wear, are not part of this maintenance. The College's Representative may request that the Contractor repair damage beds or plantings for an additional cost. All additional work shall be approved in advance by the College's Representative.

3.19 END OF MAINTENANCE

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 on the date of the final observation.

    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 Owners Representative.

END OF SECTION

SECTION 334111
SITE STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Storm drainage piping, fittings, and accessories.

B. Connection of drainage system to surface outlet or campus drainage system.

C. Catch basins, curb inlets, trench drains, area drains and site surface drainage.

1.2 RELATED REQUIREMENTS

A. Section 015639 – Tree and Plant Protection

B. Section 017419 – Construction Waste Management and Disposal

C. Section 033000 - Cast-in-Place Concrete

D. Section 311000 – Site Clearing

E. Section 312200 – Grading

F. Section 312316 – Excavation

G. Section 312323 – Fill

H. Section 321313 – Portland Cement Concrete Paving

I. Section 321316 - Decorative Concrete Paving

1.3 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.4 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).

C. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2014

D. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012.

E. ASTM D2729 - Standard Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings; 2011.

F. ASTM D3034 - Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings; 2014.

G. DIN EN 1433 - Drainage Channels for Vehicular and Pedestrian Areas - Classification, Design and Testing Requirements; Marking and Evaluation of Conformity; 2005.

H. DIN 19580 - Drainage Channels for Vehicular and Pedestrian Areas - Durability, Mass per Unit Area and Evaluation of Conformity; 2010.

I. California Building Code, Title 24, Part 2, Volume 1 Chapter 11B; current edition.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of drainage system with size, location and installation of service utilities.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner with minimal disruption.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating pipe and pipe accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed SSPWC requirements.

D. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.

E. Field Quality Control Submittals: Document results of field quality control testing.

F. Project Record Documents:

1. Record location of pipe runs, connections, catch basins and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.2 REGULATORY REQUIREMENTS

A. Conform to SSPWC code for materials and installation for the Work of this section.

PART 2 - PRODUCTS

2.1 DRAINAGE PIPE MATERIALS

A. Provide products that comply with SSPWC code.

B. Plastic Pipe: ASTM D3034, Type PSM, Polyvinyl Chloride (PVC) material; inside nominal diameter of 6 inches, bell and spigot style solvent sealed joint end.

2.2 PIPE ACCESSORIES

A. Pipe Joints: Neoprene gasket for positive seal.

B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

C. Filter Fabric: Non-biodegradable, non-woven, Mirafi 140N or approved equal.

D. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots, integral cleanout, cleanout cover, and tamper proof fasteners.

1. Configuration: 90 degree.

2. Material: Cast iron; ASTM A48/A48.

3. Finish: Manufacturer's standard factory applied powder coat finish.

2.3 CATCH BASIN, TRENCH DRAIN, CLEANOUT, AND AREA DRAIN COMPONENTS

A. Lids and Drain Covers: Cast iron, hinged to cast iron frame.

1. Catch Basin:

a. Lid Design: Checkerboard grill, ADA-compliant if located in ADA paths of travel. Openings in grates shall not allow passage of a sphere more than ½ inch diameter. Elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel. If direction of travel is un-defined or multi-directional, openings in grates shall be no more than ½ inch in any direction.

b. Nominal Lid and Frame Size: 24 x 24 inch or as indicated per plan.

2. Cleanout:

a. Lid Design: Solid.

b. Nominal Lid and Frame Size: 6 inch diameter or as indicated per plan.

3. Area Drain:

a. Lid Design: Checkerboard grill, ADA compliant if located in ADA paths of travel. Openings in grates shall not allow passage of a sphere more than ½ inch diameter. Elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel. If direction of travel is un-defined or multi-directional, openings in grates shall be no more than ½ inch in any direction.

b. Nominal Lid and Frame Size: 6 inch diameter or as indicated per plan.

B. Trench Drain System: Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and ADA compliant grating if located in ADA paths of travel. Openings in grates within accessible paths of travel shall not allow passage of a sphere more than ½ inch diameter. Elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel. If direction of travel is un-defined or multi-directional, openings in grates shall be no more than ½ inch in any direction.

2.4 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 312323.

B. Cover: As specified in Section 312323.

PART 3 - EXECUTION

3.1 TRENCHING

A. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.2 INSTALLATION – PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.

1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Connect to building storm drainage system, foundation drainage system, and utility/municipal sewer system.

E. Make connections through walls through sleeved openings, where provided.

3.3 INSTALLATION - CATCH BASINS, TRENCH DRAINS AND CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.

C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

D. Establish elevations and pipe inverts for inlets and outlets as indicated.

E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

F. Prefabricated trench drains:

1. Excavate; prepare substrate and supports according to the manufacturer's printed installation instructions.

2. Install prefabricated trench drain system according to the manufacturer's printed installation instructions.

3. Expansion, Construction, and Control Joints: Do not locate trench drain system on an expansion, construction or control joint in concrete or pavement. Where concrete or pavement joints running transverse to direction of flow cross the trench drain system, locate concrete or pavement joints and trench drain system joints so that both coincide.

4. Concrete Trench Support: 2,500 pounds per square inch compressive strength, minimum.

a. Provide support on all sides of trench in minimum thickness recommended by trench drain system manufacturer.

b. Screed and finish top edge of concrete flush with top surface of trench drain system.

c. Do not use secondary edge finishing tools.

3.4 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 014000.

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.5 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION